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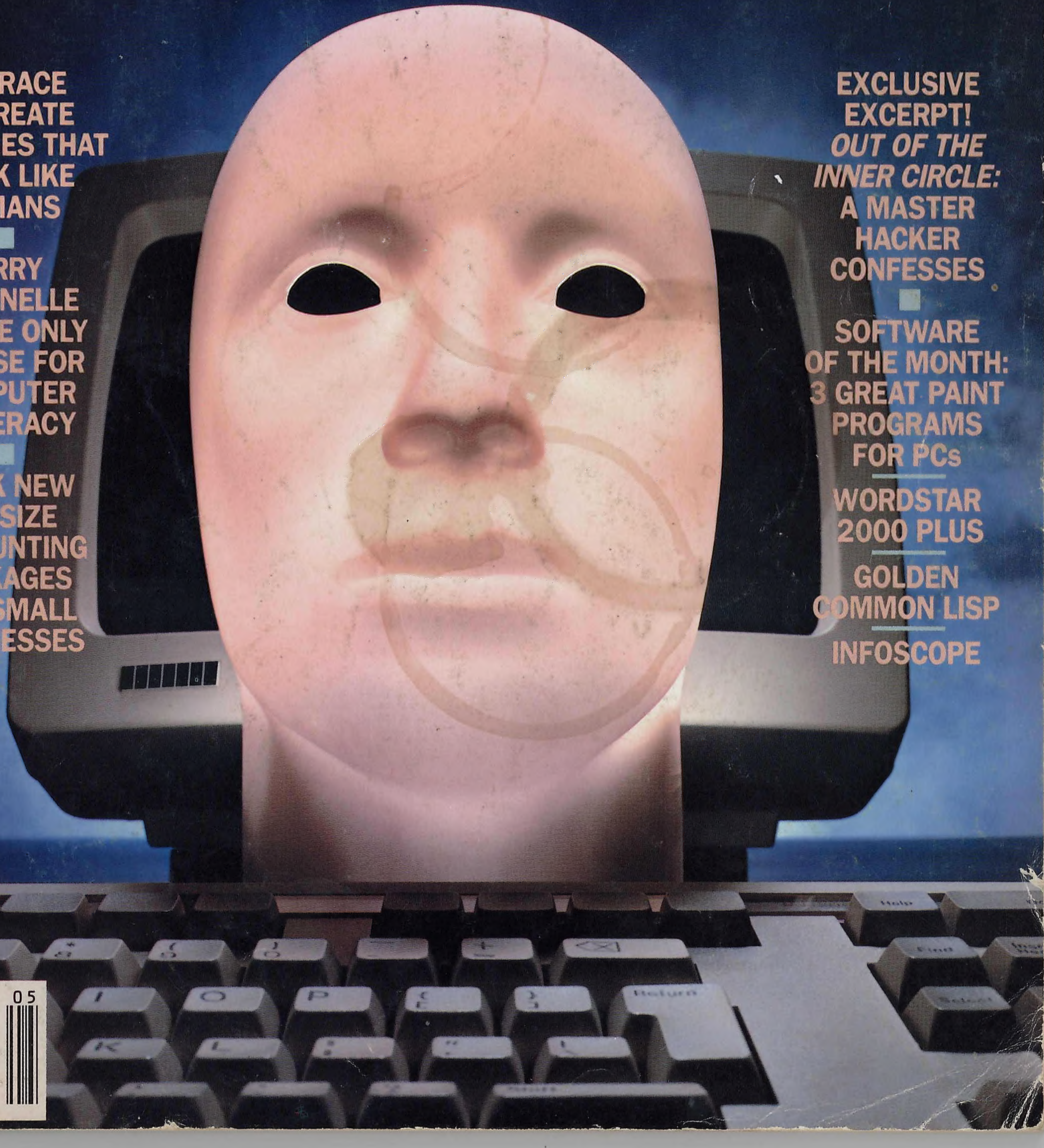

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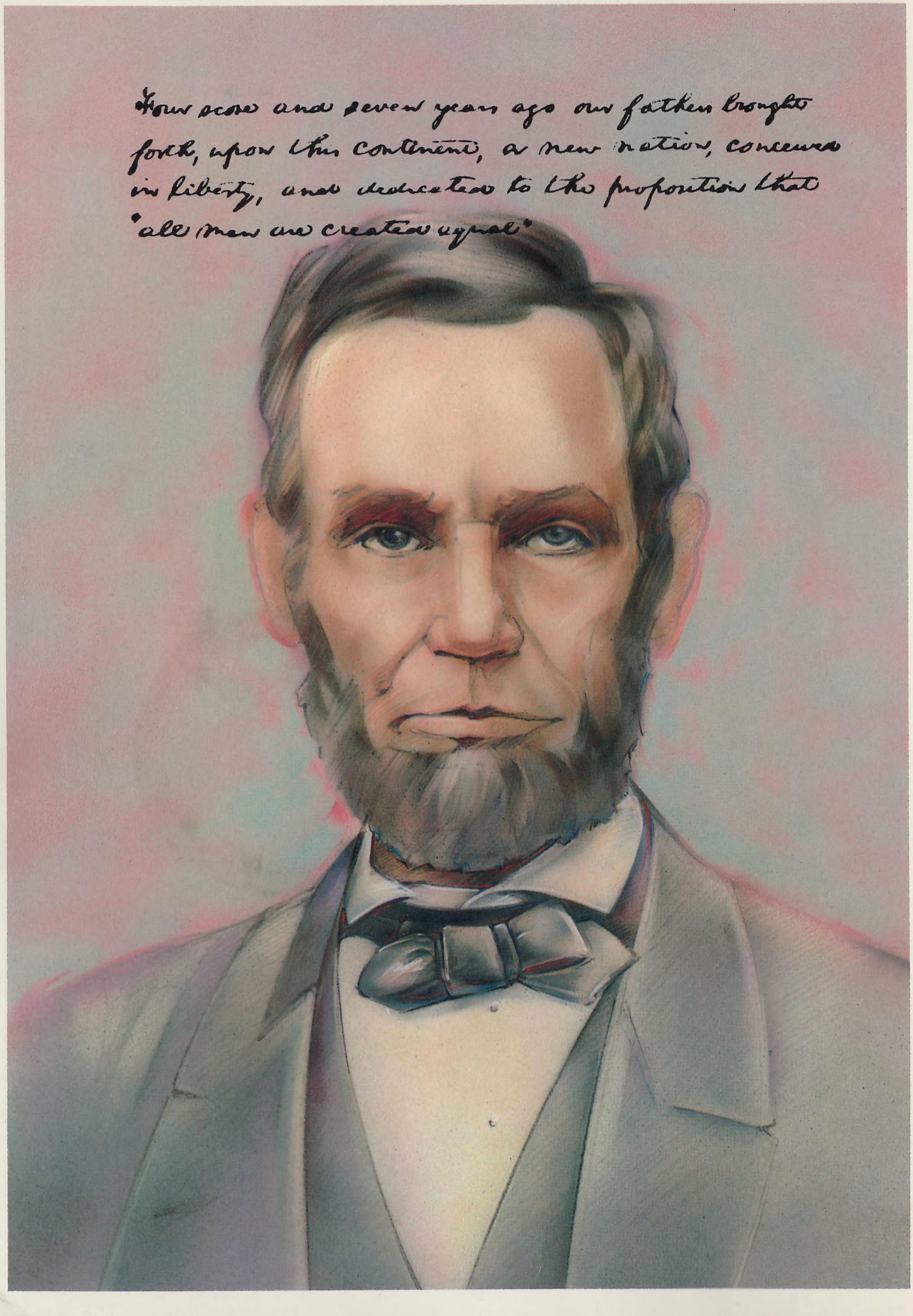
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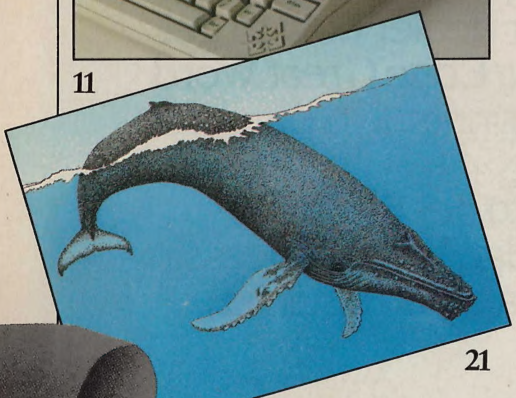

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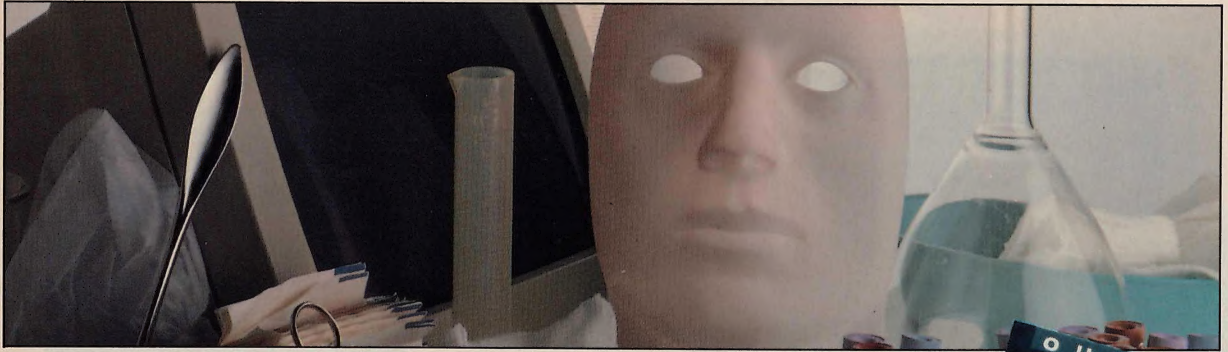

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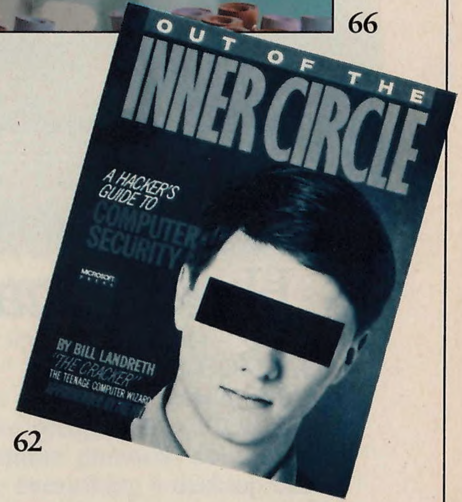

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82

On the Cover: Artificial Intelligence—Photograph by Mike Blake (Stylist: Judy Selednik); Apricot Portable (Inset)—Photograph by David Bishop

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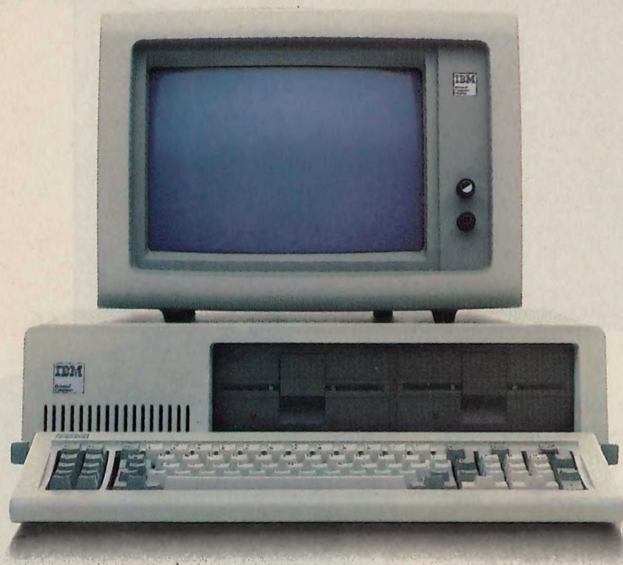

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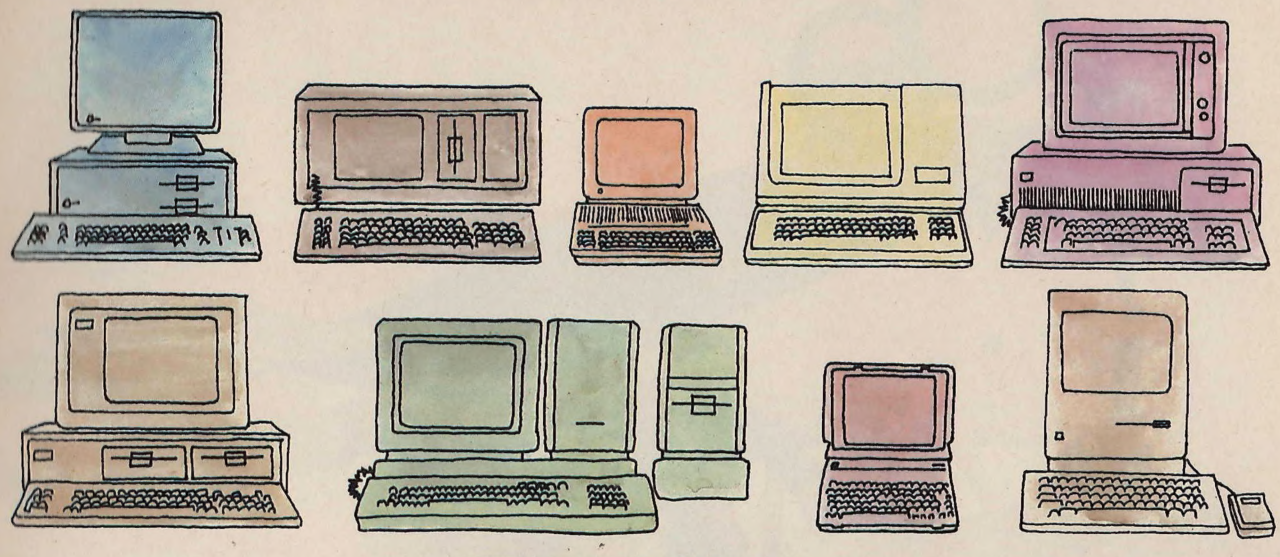

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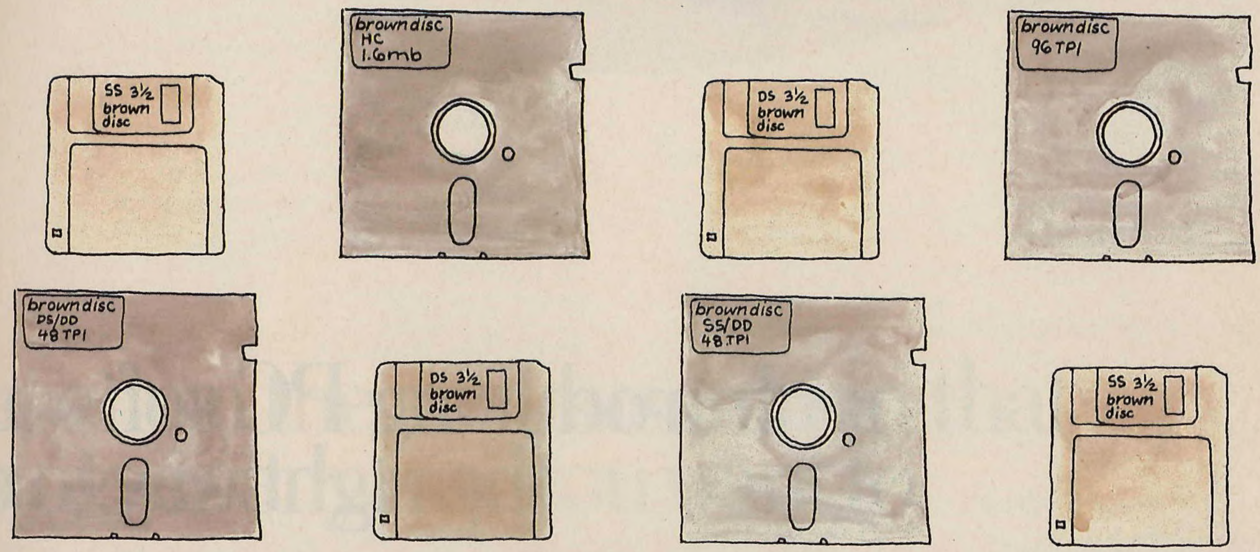

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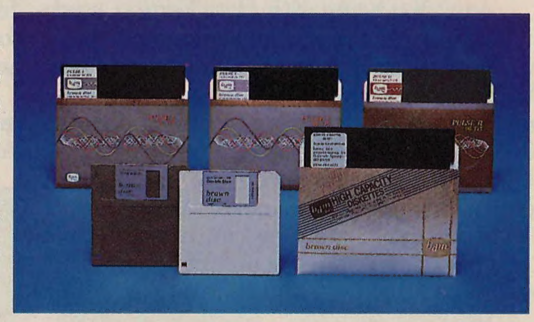

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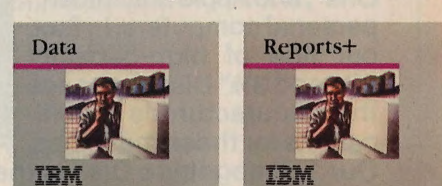

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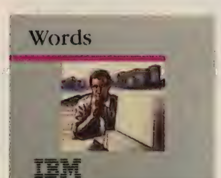

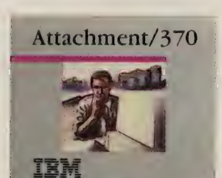

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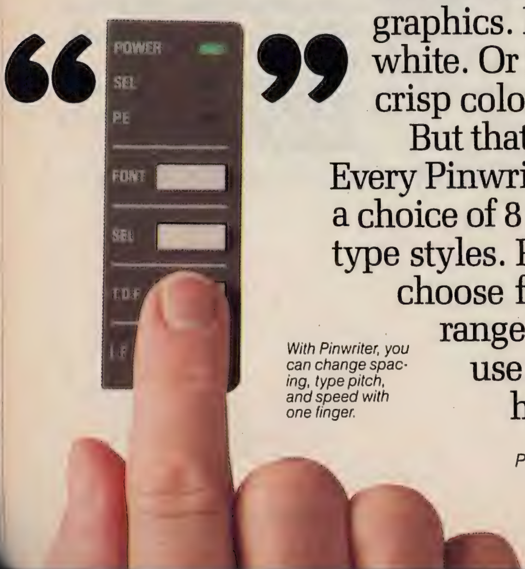

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NEWS

New Machines from Commodore and Atari

A pair of old antagonists are at it again. At the recent Consumer Electronics Show in Las Vegas, both Atari and Commodore unveiled inexpensive new high-performance home computers that promise to reheat their traditional marketing war.

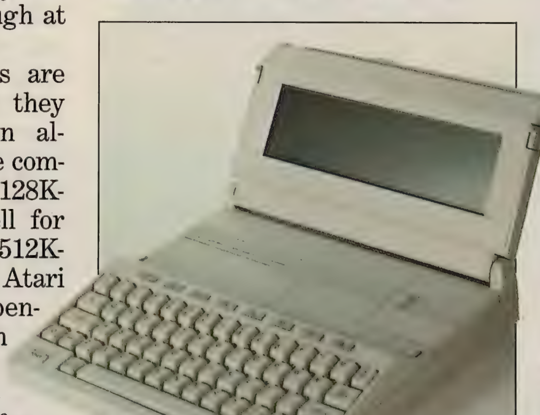
Atari's new machines are attracting lots of attention. Most impressive are the new STs, a pair of computers based on the Motorola 68000 central processor and Digital Research's Graphics Environment Manager (GEM). The stylish machines sport a Macintosh-like user interface complete with mouse, windows, and icons, but they differ from the Mac in that they can display color (although at a lower resolution).

These new Ataris are priced so low that they could shake up an already-confused home computer market: the 128K-byte 130ST will sell for just $399 and the 512K-byte 520ST for $599. Atari also promised inexpensive peripherals such as an external drive for $149, a monochrome monitor for $149, a color monitor for $199, and a 15-megabyte hard disk for only $399.

As when Apple introduced the Macintosh, the big question about Atari's STs is what software will be available. "By the time we have machines, we will have software on the shelf," promised Sig Hartmann, Atari's president for software, who indicated that 25 to 30 software packages will be ready when the 130ST comes to market.

By as late as January of this year, Atari had not delivered machines to software developers. But Hartmann claimed that developers could easily write software on an IBM PC running the C language or on an Apple Lisa and then port it to the ST machines. He also maintained that "we can take Macintosh software and port it" within two weeks to one month. Hartmann said he had commitments from 30 to 40 software developers to create programs for the new machines and mentioned specifically that Microsoft would port its Macintosh applications. But Microsoft president Jon Shirley said that while

COMMODORE'S LAPTOP—UNDER $600



the firm will look at the STs, he had made "absolutely zero commitment" to port Microsoft programs.

According to Hartmann, software that Atari sells for the STs will cost about $50 per program. While this is good news for consumers, it could discourage independent software developers by forcing lower profit margins.

Atari has also introduced its new 65XE (a repackaged version of the popular 64K-byte 800XL) and a new 128K-byte version called the 130XE. The machines feature better keyboards and are reportedly less expensive to make. Atari officials expect that, by year's end, the 65XE will be available for about $99 and the 130XE for about $149.

"We expect to sell 5 million computers [in 1985]," says Atari chairman Jack Tramiel, formerly head of Commodore. Most of these sales will come from the XE line, but Tramiel predicts the firm will be manufacturing 200,000 STs every month by the end of the year.

Not to be outdone, Atari's archrival, Commodore, introduced two machines that are scheduled to be shipped late this spring.

The new Commodore 128, which the firm says is completely compatible with all Commodore 64 software, offers some notable increases in power and capability. It includes 128K bytes of user memory that can be expanded with RAM-disk modules, an 8502 central processor that maintains C64 compatibility while handling the 128's additional memory, and a Z80A coprocessor that enables the computer to run CP/M software. Also, the 128 will display 40 or 80 columns in color and is supported by a new, faster floppy-disk drive. Suggested retail price is expected to be under $300.

Another new entry at a surprisingly low price is the laptop Commodore LCD, which will sell for less than $600. The 3-pound machine runs on batteries or AC power and uses a proprietary 80-column by 16-line LCD screen, one of the few made in the United States. A built-in 300-baud modem, 72-key keyboard, BASIC, and word-processing, spreadsheet, filing, scheduling, and communications software are all included in the LCD's price.

Despite these new products, though, Commodore will continue to push its extraordinarily popular Commodore 64 in the U.S. About 4.5 million Commodore 64s, which now retail for less than $200, have been sold thus far, according to Frank Leonardi, Commodore's marketing vice president.

Both Atari's and Commodore's new computers are impressive, but they're not the last word. By this summer, Atari plans to introduce a computer based on a true 32-bit processor, and Commodore expects to formally unveil its long-awaited Amiga computer, which uses special chips to produce color graphics, animation, and sound in yet another Macintosh-like environment.

While Atari will stay with mass-market retailers for its 68000-based ST line, Commodore hopes to move the Amiga into computer specialty stores. Targeting the small-business arena, Leonardi says, "We think we can compete with IBM and Apple."

We'll have to see about that, but for now it's clear that both Commodore and Atari intend to push the state of the art in home computers and provide lower-cost alternatives to traditional business microcomputers. —MICHAEL J. MILLER

ATARI CHIEF JACK TRAMIEL PROMISES POWER WITHOUT THE PRICE FROM THE NEW ST.

Is It Real or Is It MSX?

In last October's cover story we considered the potential of the Japanese/Microsoft MSX computers and advised you to wait and see what would happen during the first few months of 1985. However, despite a prominent Microsoft/MSX exhibit at January's Consumer Electronics Show, you may want to wait a little longer.

MSX is an industry standard that has grown from a common agreement among nearly a dozen Japanese companies. An 8-bit Z80 microprocessor, special video and audio chips, and a 40-column display form the core of MSX, and Microsoft has been working to create an 8-bit version of its MS-DOS operating system for the Japanese computers. All firms involved with MSX hope to profit from low prices rather than technological innovations.

Last year, several MSX developers laid plans to launch their products in the U.S. during 1985; this year, 12

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Inquiry 77

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Inquiry 28

Japanese firms showed off their MSX computers in a common booth. A promotional brochure exclaimed: "Discover it . . . Rely on it . . . Profit by it . . . what you've been waiting for . . ."

The trouble is that we're still waiting. Japanese firms have entered the European market, but they're still doing market research in the United States. Companies such as Sony, Panasonic, Yamaha, and JVC have been selling systems in Japan for nearly a year but aren't yet exporting their wares to this country.

Although MSX machines share a standard configuration, each manufacturer has focused on its own special features. For example, JVC computers can be connected to audio and video systems. Yamaha's system has a music synthesizer that accommodates the company's musical keyboards. And the most expensive Sony MSX computer, known as the Hit Bit, has software in ROM that works with a videodisc recorder to overlay computer graphics on prerecorded video images.

But unless some of these Japanese firms expand their marketing and distribution, manufacturers like Apple, Commodore, and Atari may well leave them in the dust.

—PAUL FREIBERGER

Apple Improves the IIe

It doesn't have the flash of the Mac or the sleek lines of the Apple IIc, but the Apple IIe has provided the firm's bread and butter over the last two years. Now Apple has made some enhancements that it hopes will ensure continued growth for its quiet best-seller.

The biggest change is that four of the machine's electronic chips have been upgraded. A 65C02 central processor—a newer CMOS version including additional programming instructions—replaces the original 6502, and a new character-generating ROM chip provides the mouse-text graphics and icons developed for the IIc. Two monitor ROM chips have also been upgraded.

These changes make the IIe completely compatible with the IIc. Programmers can now combine such functions as print spooling and smoother graphics animation in a single program that works on both machines. Also, BASIC will now support uppercase and lowercase characters, and you'll be able to start the ProDOS operating system from a Profile hard disk. Finally, the new IIe has a mini-assembler language in ROM, a feature included in the original Apple II but not in subsequent members of the family.

In addition, the IIe will have a new owner's manual, a tutorial disk, and new packaging, all patterned after similar items developed for the IIc.

Though Apple refers to the machine as an "enhanced" IIe, its price will remain the same. A basic configuration including 128K bytes of memory, an 80-column display card, monochrome monitor, and a dual disk drive carries a suggested retail price of $1795. Over 200,000 IIes were sold between October and December of last year, the best quarter ever for the machine.

Owners of earlier IIes have not been forgotten. For $70, an Apple dealer will replace the older chips with the upgraded versions.

Like the IIc, the new IIe will not run about 10 percent of the programs written for earlier IIs. Apple hopes to prevent frustrations by distributing a list of problem software to its dealers.

In the long run, Apple expects the IIe to be the mainstay of the II family in the educational market and in the upper end of the home/small-business market. The IIc, which has a lower price, is expected to sell better in retail stores. Despite anticipated competition from Commodore and Atari, though, Apple has no plans to sell machines in mass-market outlets such as K Mart. As Apple IIe product manager Peter Levy puts it, "We believe that the personal computers we make require the kind of support our outlets provide." —MICHAEL J. MILLER

Lisa Has Name-Change Operation

THE APPLE LISA? NO, THE MAC XL.

Two years ago, Apple did everything it could to make sure you remembered Lisa, the name of its new computer. But now the firm will be trying to make you forget.

As part of a move to reposition the 512K-byte Lisa 2/10 as an "extra large" Macintosh, Apple has rechristened it the Macintosh XL. The renamed machine has also been repriced at $3995 (down from $5495, but still $1200 more than the 512K-byte "Fat Mac"). For the extra money, a Macintosh XL owner gets an internal 10-megabyte hard disk and several expansion slots for hardware options such as AST Research's 2-megabyte memory expansion card.

According to product manager Randy Battat, the name change stems from Apple's desire for a "clear, consistent product line." Pur-

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suing this goal to the end, the company will no longer sell the old Lisa operating environment or the Lisa 7/7 integrated applications series. Instead, the Macintosh XL will come with Macworks XL (a new version of the Macintosh operating system that will let you boot from the hard disk) and will be able to use Apple's new Laserwriter printer and Appletalk network, thus tying it in with "the Apple office."

Current Lisa owners will be offered a special upgrade package including the Macworks operating environment, MacDraw, MacProject, and Jazz, an integrated software system from Lotus Development Corp. The upgrade, which will be released in late spring and sell for $400 to $450, will also include programs for converting from the Lisa 7/7 series to Jazz, MacDraw, and MacProject.

But whatever you call it, the Macintosh XL differs notably from other members of the Mac family. It has a larger display area that handles more columns of text or spreadsheet data, but the display uses larger pixels, which tend to make characters look elongated. (Battat did say that Apple will supply dealers with a mechanism to adjust the display to make this less noticeable.)

Also, the XL uses several different chips than the Macintosh, including a slower version of the Motorola 68000 central processor (5-MHz as opposed to the 8-MHz processors in other versions of the Mac). This will make the XL slower at actual processing—recalculating a spreadsheet or drawing a graph, for instance—although the internal hard disk makes reading and writing information much faster.

Sales of the old Lisa never matched Apple's hopes for the product, due in part to its high price ($10,000, including software, when first released) and the company's later emphasis on the Macintosh.

—MICHAEL J. MILLER

News and Observations are compiled by West Coast editors Michael J. Miller, Paul Freiberger, and Jonathan Sacks.

Observations

Micropro Reversal

In one of the shortest copy-protection experiments in history, Micropro announced in February that it had removed the copy protection from its Wordstar 2000 word processor. When the product was released 10 weeks earlier, Micropro had stressed the protection, saying it would secure the company against illegal software piracy while still letting users install the software on a hard disk. However, Wordstar 2000 users reported that installing the copy-protected program was difficult and inconvenient. More important, although the program worked on the IBM PC, XT, and AT, the copy-protection scheme prevented it from running on many "IBM-compatible" machines and even on many IBM PCs with hard disks from other firms. Micropro will be sending free upgrades of its non-copy-protected software to registered owners of the earlier version. The firm stressed that it was still concerned about piracy and said it had filed suit against American Brands for illegally copying its product. Micropro CEO H. Glen Haney says there are probably as many illegal copies of the original Wordstar as legal ones.

Games Keep on Coming

Entertainment software isn't dead yet, if we are to believe the rash of recent new product announcements. Epyx Software has picked up Rescue from Fractalus and Ballblazer, the two Lucasfilm games originally developed for Atari. And interactive fiction remains quite popular, with Bantam and Imagic combining to bring us computer versions of a new Sherlock Holmes adventure and R. A. MacAvoy's Damiano books. Infocom, the leader in interactive fiction, dramatically introduced a new game called Suspect by enacting a murder at a fancy party the firm hosted at CES. Other unusual programs will soon hit the shelves. Broderbund Software's The Ancient Art of War lets you design battle campaigns. In Eduware's Wilderness, you are the sole survivor of an airplane crash and have to find your way to civilization, braving various realistic hazards. In Activision's Rock N' Bolt, you construct a building while dancing to the rock music. And the beat goes on . . .

Coleco Forsakes Adam

The other shoe dropped at Coleco, and it didn't land in the Cabbage Patch. Following substantial losses, the firm announced in early January that it has discontinued production of its Adam home computer and sold the remaining inventory of hardware, peripherals, and software to a retail chain. The company does plan to continue producing software for the Adam as well as marketing hardware and software for its Colecovision game system. Coleco executive vice president Morton Handel blamed Adam's demise on continued bad press stemming from the poor quality of the first machines.

The Future Is Here

Everyone talks about the home of the future, but General Electric and Mitsubishi are doing something about making it a reality. General Electric's Homeminder home-control system works through existing wiring to adjust temperatures, dim lights, and turn appliances on and off at specific times. And Mitsubishi has introduced a complete electronic setup that controls all sorts of devices, including infrared cameras, air-conditioning units, stereos, appliances, a digital television that can show nine channels at once, and—oh yes—computers. You can even control the system when you're away from home by punching in special codes on a Touch-Tone telephone.

Waistline Editing

If you've gained some pounds from sitting around and staring at your computer monitor, a couple of new programs may help. Bantam Electronic Publishing, a new division of Bantam Books, will offer The Complete Scarsdale Medical Diet, a program based on the best-selling diet book. And Scarborough Systems will counter with The Original Boston Computer Diet, which features three conversational counselors.

TELECOMPUTING

TELEGUIDE'S MENUS MAKE FOR EASY ACCESS.

Public-Access Videotex

Still faltering in homes, videotex finds a market in airports, malls, and hotels

John and Cary vacationed in Toronto, a spot they picked partly because they'd never been there before. After a day of exploring the city, they were beginning to poke around for a restaurant when John nearly bumped into an off-white pedestal supporting a computer terminal. The object, labeled "Teleguide," invited them to use it. Cary started pushing buttons, and almost immediately she found her way to an extensive electronic restaurant guide complete with colorful computer graphics.

By selecting from the system's menus, she and John set up a multicriteria database search that quickly yielded a dozen pages of information on each of several nearby restaurants. After reading the restaurant menus displayed on the terminal's screen, they chose a Japanese sushi place. A computer-drawn map showed them exactly how to get to it. Then they went through the entertainment section and found a show they wanted to see. They even got the next day's weather.

What John and Cary encountered is known as public-access videotex, and their experience is being repeated daily in shopping centers, airports, office buildings, and hotels all across the continent. Fifty systems, ranging in size from Toronto's Teleguide—with 500 terminals in 200 locations—to single-terminal services running on IBM PCs, are in operation, and more are being installed every week. Such systems store information and graphics as preset pages that you can call up at no charge from easy-to-use menus. To enhance its appeal, public-access videotex emphasizes colorful displays and fast delivery. Teleguide, for instance, finds and displays its pages in less than two seconds.

Toronto Teleguide and similar systems in San Francisco and Phoenix offer thousands of pages of information, including stock and precious metals prices, hotel information, store guides, and even a mortgage payment calculator. Other companies are putting systems in malls to tell shoppers about stores, sales, and special events.

Having flown into San Francisco on business, Al decided to try a Teleguide terminal at the airport. Without any trouble he found out about local transportation and even learned where to find that present he had promised his wife. The system was so easy to use that he browsed for a few more minutes through the sections on visitor attractions and entertainment.

San Francisco International is the first North American airport to get full public-access videotex. During the first month the airport terminals were on-line, total use of the citywide Bay Area Teleguide, younger sister to Toronto Teleguide, jumped 30 percent. Besides flight schedules and local information, the system gives travelers complete access to the databases on other Teleguide systems, soon to include three more U.S. cities and two cities in Asia.

But San Francisco will not be the only on-line airport for long. The New York Port Authority has signed a contract with Videodial, the U.S. branch of a French firm, to put together a public-access system for New York's airports and train and bus stations. On a smaller scale, Ottawa's municipal bus company, O-C Transpo, operates a public-access system at major bus stations. O-C Transpo's terminals help passengers find their way around the bus lines.

Visitors to Boston's City Hall Plaza will find that the city's Info-Boston videotex system offers a unique twist: not only do you get the text and graphics featured on other public-access videotex systems, but you can also see full-motion video recordings. Each terminal has a videodisc player that, thanks to the technology's ability to find any point on

ILLUSTRATION BY BOB SCOTT

the disc almost instantaneously, can display user-selected video sequences of many of Boston's attractions.

Part of the InfoAmerica chain, the major competitor to Teleguide for citywide systems, InfoBoston relies on terminals with touch screens rather than traditional keyboards. To select a menu item, you simply touch the appropriate spot on the display. While this technology is easier to use and somewhat less intimidating, dirty screens can be a problem. InfoBoston does not have many terminals around the city yet; consequently, the system has not attracted lots of attention.

On her way to work, a Toronto executive stops at a Teleguide terminal as part of her daily routine. She punches in the page number for the London gold prices and finds that they are up—when she gets to the office she'll sell. Her gold price check is just one of 850,000 Teleguide accesses in a typical month—more than 10 million a year. Although some of these are quite brief, the average session lasts 20 minutes.

Teleguide offers 1700 pages from 500 information providers, all advertiser-supported. To keep people coming back, the system features many services that are useful over and over again, ranging from updates on sports scores to an airplane travel planner that quickly maps alternate flight routes and lists appropriate air schedules and fares.

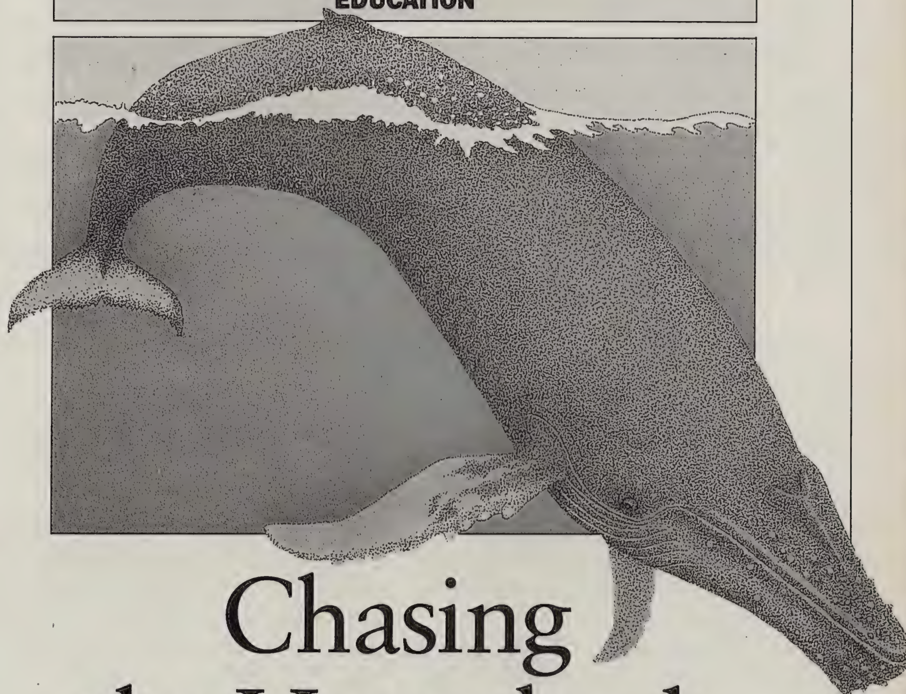
Teleguide has already started putting terminals in Toronto hotel rooms, and several other operations are also after the hotel market. International Anasazi Inc. of Phoenix has developed a terminal that doubles as a microcomputer for hotel guests. Besides using the terminal to get information or order from room service, you can "rent" a word processor, electronic spreadsheet, or other software. The program you choose is downloaded into the terminal from the host computer and used off-line. The entire system is integrated into your room's TV, which it uses as a screen—you indicate your choices by selecting a TV channel rather than by going through menus.

In the old days, broadsides posted in public places answered the same needs for information that today's newspapers do. Similarly, today's successful public-access videotex systems may be the harbingers of heavily subscribed home videotex services. At least so hope videotex developers, who envision a day when millions of people will use their home phones and computers to read the news, do their shopping, make reservations, and get all the other information essential to daily life.

—G. Berton Latamore

G. Berton Latamore is a freelance writer and the editor of *VideoPrint.*

EDUCATION



Chasing the Humpback Whale

The Voyage of the Mimi: a new course in science education?

Take an old sailing vessel. Add a crew of young scientists and a grumpy captain with a passion for sea chanties and place them amid a pod of magnificent whales. Throw in a concern for computer literacy, some leading software designers, a top-notch television producer, and a budget of almost $4 million. The result is The Voyage of the *Mimi*, a multimedia science curriculum for grades 4 through 8 developed by the Bank Street College of Education and published last fall by Holt, Rinehart, and Winston.

All in all, the *Mimi* package, with 26 fifteen-minute video programs, a 160-page full-color reference book for students, a teacher's guide, four software modules, and two wall charts, has a lot to offer. Half of the video segments recount the fictional adventures of six young scientists studying humpback whales off the

coast of New England, and half focus on visits to scientific laboratories and emphasize the activities of real-world scientists. The software modules include an excellent navigation game, an introduction to computers through turtle graphics, and a laboratory tool kit to collect, analyze, and graph scientific data in the classroom.

Samuel Gibbon, a former producer of both *Sesame Street* and *The Electric Company*, was executive director of the entire project. Tom Snyder, the man behind educational software such as Snooper Troops and the Search series, and Robert Tinker, a leading developer of science software for classroom laboratories, were among those who devised the software for the project.

All parts of the package aim to make the process of science real to children. The dramatic episodes make scientists and their work come alive for young viewers, while the book and the charts provide lasting reference material. The software gives students a chance to pursue knowledge actively, the way real scientists do.

The real strength of the *Mimi* package is the video episodes. The cast includes two marine biologists, a college student, two high schoolers, the captain, and his 11-year-old grandson. The story highlights the role of technology in scientific endeavors.

One episode, for instance, shows the crew photographing whales to record the identifying markings on their tail flukes. Later, the researchers match the markings with records from an earlier mission stored in a computerized database. In another scene, the shipboard computer gathers and graphs information about ocean depth and temperature as the *Mimi* sails through the whales' feeding ground. Throughout the voyage, electronic equipment for communications and navigation plays a central role.

The *Mimi*'s voyage also stresses the importance of collaboration. Each researcher has a role to play, and it quickly becomes clear that the resulting whole is much more than the sum of its parts. Moreover, the relationships among the young researchers reveal the human side of scientific research. And just in case the science itself is not enough to hold an audience's attention, the episodes include regular doses of humor, adventure, human interest, and even a hint of romance.

> **RESCUE at Sea, which simulates nautical navigation, should put a healthy dose of real life into the frequently boring classroom study of mathematics.**

The project's computer activities reinforce the goal of familiarizing kids with the scientific process. The programs that simulate nautical navigation are particularly appealing. The main program, Rescue at Sea, has several teams of rescuers competing to locate and assist a fishing trawler that has accidentally trapped a humpback whale in its nets. Given a chart and a logbook, each team uses realistic navigational aids in its rescue attempt.

At the start, each team must determine the location of its own boat by taking bearings on two radio beacons and marking the intersection on the chart. Then players note the latitude and longitude of the troubled trawler and set their own vessel's course accordingly. Radar helps to give more precise information about the course and location of any ship within a 30-mile radius. Within about 9 miles, binoculars come into play—the rescuers are able to see a nearby vessel for the first time and determine if it is the trawler they seek or one of the competing teams.

Although the process is simpler than real-world navigation—there are no tides, winds, or rock ledges to account for—precise mathematical knowledge and careful attention to detail are critical to success. A workbook and three simpler preparatory programs help students learn navigational terminology and practice the necessary skills before applying them in the game. All told, the navigational simulation should put a healthy dose of real life into mathematics, which too often is only a boring classroom abstraction.

Compared to the excitement and skill-building involved in Rescue at Sea, the software that makes up Introduction to Computing with Turtle Graphics is less compelling and not really integrated with the rest of the series.

The program called Turtle Steps, however, is a thoughtful and provocative introduction to turtle graphics, even though it has nothing to do with the voyage. Its turtle, unlike the ones in most other turtle graphics or Logo systems, rotates and moves slowly and deliberately, which allows a beginner to visualize readily the effects of commands such as FORWARD 20 or RIGHT 60.

Moreover, Turtle Steps provides an intriguing set of challenges. The game begins with a series of small circles on the screen, and students have to move the turtle to as many circles as possible with a limited number of moves. Because the circles are arranged in different patterns for each game, the emphasis is on planning carefully, creating reusable procedures that combine several commands, and using the REPEAT command.

A third notable feature of this software module is a pair of tools to help students estimate angles and distances. If you choose the angle tool, a circle appears on the screen with a rotating line that lets you select an angle for aiming the turtle. The distance tool lets you measure the distance from the turtle to any point in

For more information on The Voyage of the *Mimi*, contact Janice Trebbi Richards of Holt, Rinehart, and Winston, 383 Madison Ave., New York, NY 10017.

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Inquiry 29

All in all, WordPerfect is absolutely stunning.

PC Magazine

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front of or behind the turtle's current position. Because the use of these tools doesn't count as a "move" in the game, students feel encouraged to use them often.

Unfortunately, the documentation with Turtle Steps merely rehashes familiar material unrelated to both the turtle games and the video episodes. Students don't need another book about bits, bytes, and Babbage. And although the 26-page booklet includes a thorough set of instructions, it doesn't help students or teachers understand the mathematical significance of turtle geometry or why they might want to learn Logo, the programming language on which Turtle Steps is based.

As part of a computer literacy curriculum, The Voyage of the *Mimi* should be a success. Students will see a realistic portrayal of the computer's role in the process of gathering and analyzing scientific data. Rather than sacrificing credibility by characterizing the computer as a magical tool, the package shows that the machines are used for specific tasks when needed but otherwise stay very much in the background.

Except for the turtle graphics, computer activities support what the students have seen in the video segments. They help students learn some of the mathematics of navigation as well as the data-gathering and analytical skills essential to scientific experimentation. All told, the Voyage of the *Mimi* is clearly an effective way to promote both scientific literacy and computer literacy.

Nevertheless, the *Mimi* leaves some questions in its wake. The educational merger of computers and video charts no new course: the two strands in this package are parallel rather than truly integrated. And high-quality educational TV is a costly proposition. Earlier projects such as *Sesame Street* and *The Electric Company* required years of government funding before they became self-sustaining. In a period of high deficits and massive budget cuts, risky and expensive new projects like the *Mimi* are unlikely to receive much federal support. Educational publishers will have to create similar projects on their own—without Uncle Sam's money—or the *Mimi* may remain an isolated example of how electronic media can support scientific literacy rather than serving as the model for future endeavors.

—DAN WATT

Dan Watt is a contributing editor of *Popular Computing* and the author of *Learning with Logo* (BYTE Books/McGraw-Hill, 1983).

BUSINESS

New Wave Accounting Systems

A flurry of midsize packages answers the needs of many small businesses

The Fortune 500 may get the headlines, but 86 percent of the businesses in this country have fewer than 20 employees. That's about 20 million small businesses and professionals. These bicycle shops, interior decorators, consultants, psychologists, and the like all share an ongoing problem—taking care of the financial side of things.

Until recently, you had to fork out a couple of thousand dollars and slog through a long learning curve to computerize bookkeeping and accounting procedures. Happily, this is changing. If you've been put off by accounting software that looks like it's priced and designed for General Motors, take another look.

The new wave in accounting software emphasizes simplicity and lower costs. And while the ugly truth about accounting is that it's not much fun, it's also true that the alternative to organization and regular maintenance of the business books is annual hysteria at tax time.

If this new wave is so great, what do you buy? I'll make some suggestions later on, but first a little neo-Freudian analysis of your business activities is in order.

ILLUSTRATION BY BOB SCOTT

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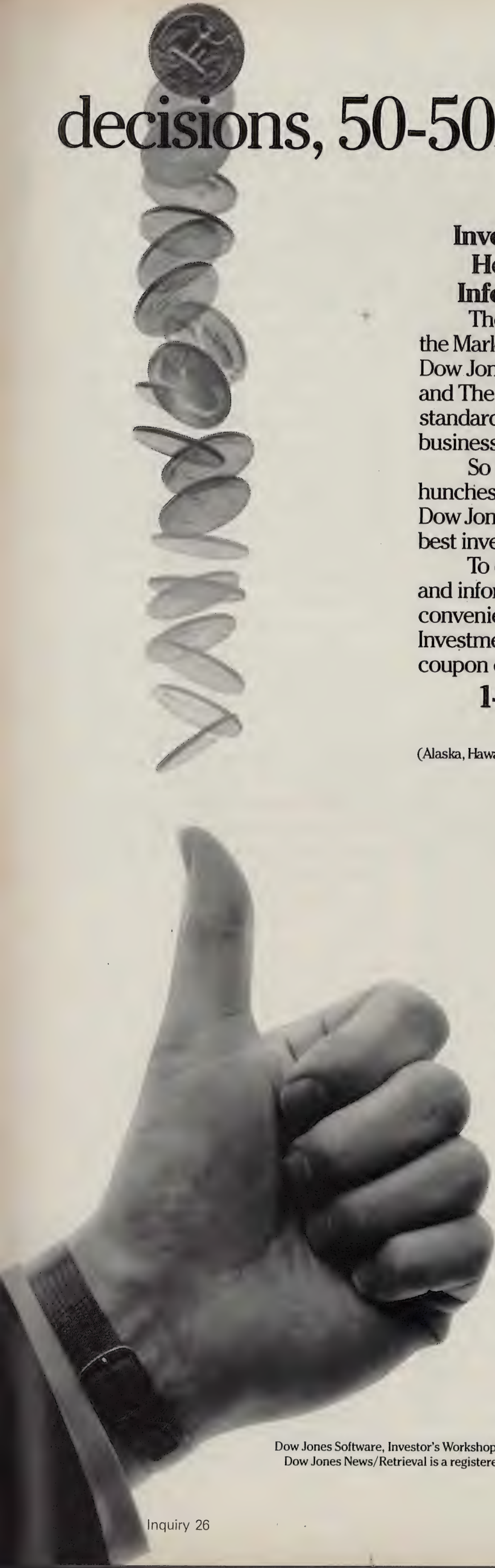

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What are you? This is an odd but important question, for some of the new wave accounting packages are tailored to particular lines of work. A lawyer who does a large volume of wills or other relatively brief client services may have a real need for computer-based time accounting, billing, and accounts receivable. Another lawyer may be just as happy sending out occasional bills by hand and entering totals in a general ledger each month. Business person, know thyself.

Where are you going? If you operate a two-person carpentry shop, do you ever see yourself becoming bigger, maybe opening a small factory someday? The likelihood of growth means you have to consider whether a particular accounting program will accommodate your expectations; otherwise you'll need to convert to other software in the future.

When selecting a program, keep an eye toward the future as you examine the maximum number of accounts and transactions the software allows, whether it can use a hard disk for greater storage capacity, and even whether it (or a big brother version) is offered as a multiuser package.

How are you keeping your books now? Your answer may be disheartening, but the question is absolutely essential. Don't despair, though—most often, the more haphazard your current procedures are, the easier it is to convert to an automated system. You're basically starting from scratch, and almost any program will be an improvement.

Do you have an accountant? If so, he or she is an important person to check with. Your accountant can help select a program that is reasonably compatible with the methods he or she uses to write up your financial and tax information. But a word of caution: accountants keep books for people professionally; you do it only as a sideline. It's better to use a simple accounting program that you will be able to keep up to date than to have an accountant's dream system that's so daunting you can't face it on a regular basis.

Accountants get bum-rapped all the time as dull, unimaginative creatures. I'm sure that's true in some cases, but much of their stodgy image comes from the fact that they're doing a lot of mundane clean-up work. Because accountants are a pricey commodity, wouldn't it be better to spend the same dollars for professional tax strategies and investment advice and let a microcomputer chew on the dull stuff? You might find your accountant to be much brighter than you thought.

AFTER being roundly ignored by software developers for so long, small-business people are now being pursued like rock stars at a groupie convention.

What do you want from an accounting system? Maybe it's as simple as peace of mind—knowing that things financial are In Control (as Winnie the Pooh might say). Perhaps colorful charts showing budgeted versus actual expenses would help you spot important patterns—some people gray out when faced with endless columns of figures. Maybe your billing follow-up is lousy and you want to keep income from dribbling through the cracks. Accounting systems aren't created equal; they need to be matched to what you're trying to accomplish.

Answering these questions puts you in a better position to recognize what you need, so now you're ready to look at some of the more promising new accounting programs. This is hardly a comprehensive survey, but the following programs should suit specific segments of the small-business world.

If yours is one of the 5 million or so companies using "one-write" (pegboard-type) manual bookkeeping, check into One-Write Plus, from Evergreen Software (The Meeting Place, Amherst, NH 03031). This $295 package cleverly turns check writing and cash receipting into a full-blown general ledger system.

One-Write Plus co-opts your CPA with a portion of the manual unsubtly titled "For Your Accountant." Said accountant is supposed to advise on how the chart of accounts is constructed and provide the opening trial balance. An overview of the program's principles and procedures is included so the accountant can have some confidence about what data he or she will get at tax time. This nicety recognizes the working relationship between most small businesses and accounting firms.

Most important, the One-Write Plus screen shows a comfortingly familiar form-like image that will minimize the learning and conversion trauma for users of manual one-write systems. The package is thoroughly documented and even looks handsome on a bookshelf.

If you're terrorized by the word "accounting" and need to be treated gently, test-drive Rags to Riches, from Chang Labs (Suite 200, 5300 Stevens Creek Blvd., San Jose, CA 95129). This package comprises four discrete, noncombative modules (General Ledger, Accounts Payable, Accounts Receivable, and Sales), each retailing for $99.95. You can choose just those parts that fit your requirements—the Sales module is a boon for a retail operation, for instance, but it's not of much use to a consulting firm. Chang also offers optional guides for service and retail businesses. In about 100 pages each, these give you a light refresher course on financial basics.

Rags to Riches is strongly oriented to very small businesses. Chang Labs promises to address this possible limitation with a built-in product-growth path to an industrial-strength accounting system in the near future.

For the upwardly mobile, Peachtree Software (3445 Peachtree Rd. NE, Atlanta, GA 30326) offers its three-piece (G/L, A/R, A/P) Back to

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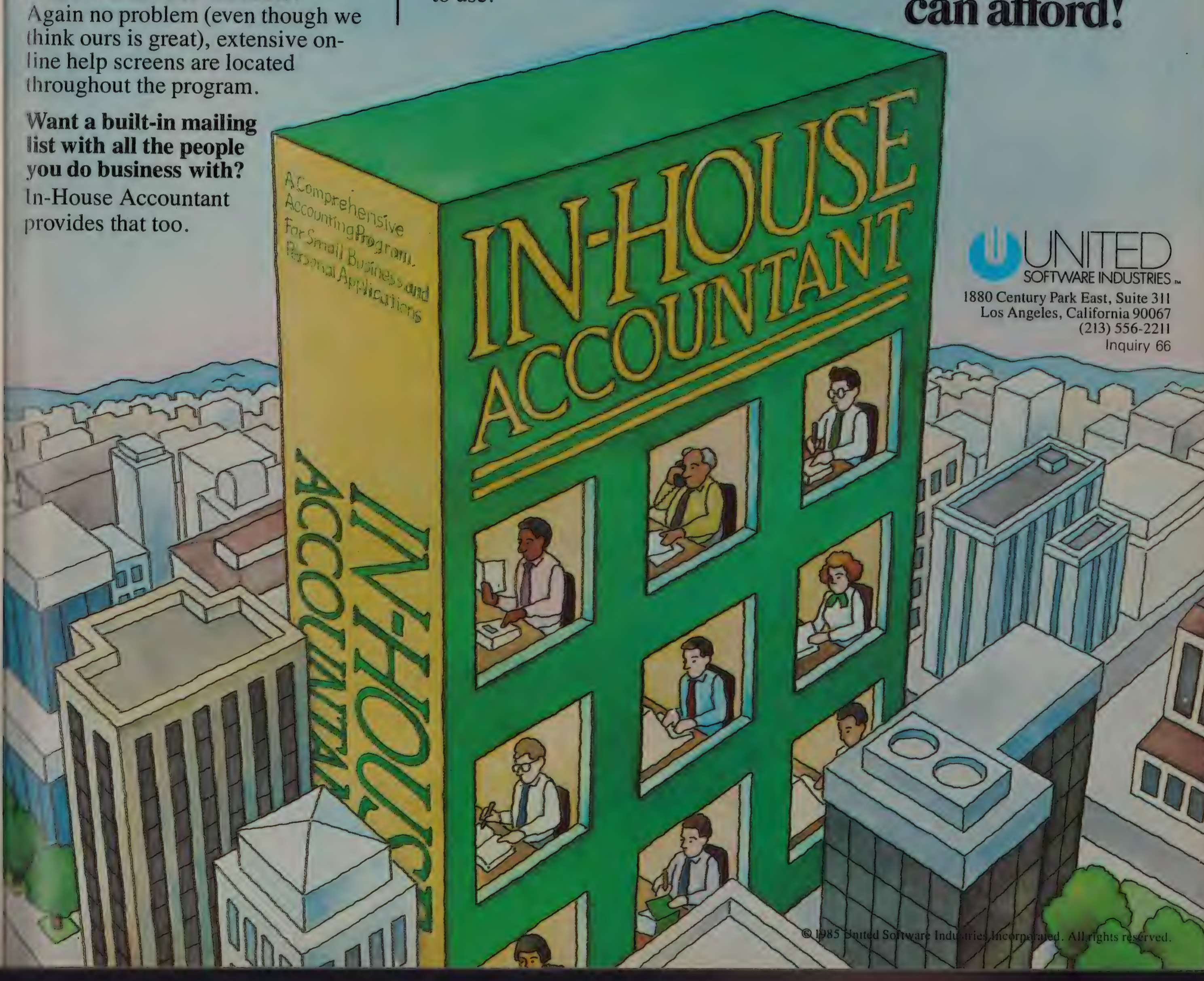

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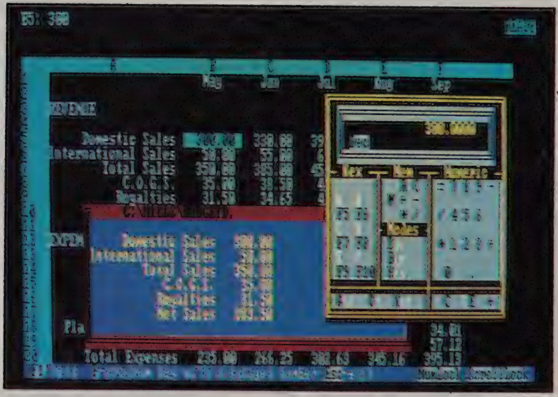
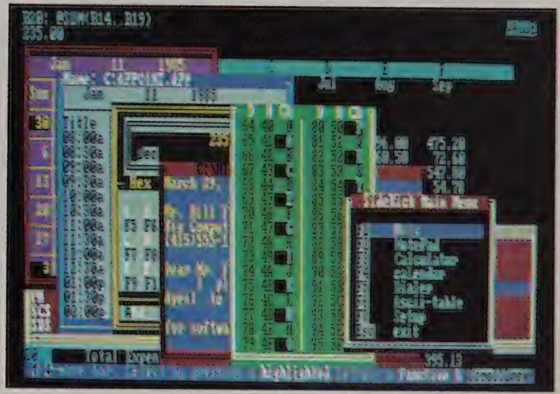


Here's **SideKick** running over Lotus 1-2-3. In the SideKick **Notepad** you'll notice data that's been imported directly from the Lotus screen. In the upper right you can see the **SideKick Calculator**.



All the **SideKick** windows stacked up over Lotus 1-2-3. From bottom to top: SideKick's **"Menu Window"**, **ASCII table**, **Notepad**, **Calculator**, **Appointment Scheduler/Calendar**, and **Phone Dialer**. Whether you're running WordStar, Lotus, dBase, or any other program, SideKick puts all these desktop accessories instantly at your fingertips.

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Jerry Pournelle, BYTE: *"If you use a PC, get SideKick. You'll soon become dependent on it."*

Garry Ray, PC Week: *"SideKick deserves a place in every PC."*

Charles Petzold, PC Magazine: *"In a simple, beautiful implementation of WordStar's block copy commands, SideKick can transport all or any part of the display screen (even an area overlaid by the notepad display) to the notepad."*

Dan Robinson, InfoWorld: *"SideKick is a time-saving, frustration-saving bargain . . . ."*

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Basics accounting program. Not as simple as others in this category, it provides good expansion capacity and covers almost any accounting situation you're likely to run across.

The 66-page manual gives you a no-nonsense discussion of accounting principles and transactions before it even begins to describe the software. If you really want to learn what accounting is about, not just schlepp through an odious task, you should give this option a lingering evaluation. Bear in mind that you'll be committing to substantial knowledge of those devilish debits and credits, and as Tug McGraw used to say, "Ya gotta believe!"

Back to Basics is one of the few accounting packages available for a wide range of personal computers, including Atari, Apple II, Macintosh, and Commodore 64 as well as the ever-present IBM PC. Prices range from $195 to $295.

If you already have a functioning, traditional bookkeeping system, you'll have little trouble understanding its electronic doppleganger called Books, put out by Systems Plus (1120 San Antonio Rd., Palo Alto, CA 94303). Books replicates a manual journal right down to its debit and credit columns, then carries the detail forward to a full general ledger with receivables and payables, all for a modest $345.

A flexible invoicing option ($100) permits descriptive billings, a plus for many professionals. A check-writing option adds another $75. Not the cheapest kid on the block, Books is a heavy-duty package that affords a relatively straightforward conversion. Books operates on the IBM PC and most CP/M-80 microcomputers.

If you are a professional with a solo practice, you have a somewhat different set of concerns. Typically, it's difficult to separate personal and professional finances: you may use a personal credit card to buy a desk for your practice or have the practice reimburse you for travel expenses. This out-of-one-pocket-into-the-other money juggling tends to drive a tax person nuts.

Best Programs (POB 2370, Alexandria, VA 22305) offers a way out of this thicket with its two-program combination, PC/Professional Finance and PC/Taxcut. The programs work together gracefully (and with federal tax forms, if you follow the suggestions on setting up accounts), dealing handily with problems like credit-card transactions, a weakness with most similar programs. PC/Professional Finance costs $245; PC/Taxcut is $255.

After being roundly ignored for so long, small-business people are now being pursued like rock stars at a groupie convention. It's not surprising. Effective accounting programs geared to this massive group will make a lot of money for their developers—as much as $2 billion per year by 1989 if you believe industry pundits.

In your search for the right accounting software, keep your eyes open—a number of new packages are ready for release, angling for a slice of that rich pie. Focus on what you need to organize and better understand your business financial picture (and what you need to satisfy the IRS). Look for software that meets these needs and that doesn't require a Ph.D. to understand or a bank loan to purchase. The idea is to solve a problem and get back to work, not to create a series of new problems.

When you find the right package, I'd suggest that you buy it from your local software dealer. With other types of software I'd urge shopping around for the best price, but accounting software needs a greater degree of hand-holding than most. Buy from a dealer who impresses you as being thoroughly conversant with the program you want and willing to answer the inevitable questions. The extra cost of buying this way instead of by mail or through a discount house will generally be repaid with dividends.

Last, don't get antsy when you find you can't achieve accounting Nirvana in a couple of hours. It's going to take a while before an automated system becomes second nature, but it will be worth it.

I say this from the fairly bitter personal experience of sorting through the archetypal shoebox full of paper to reconstruct three years of auditable business records—the IRS provided the motivation, not my strength of character. Time is indeed like money. You have to spend some to make some.

—RICHARD DALTON

Richard Dalton, an editor of the newsletter *Open Systems: Managing Office Technology*, heads Keep/Track Corp., a San Francisco consulting firm.

TECHNOLOGY

Parallel Processing

Processors team up for faster, cheaper computing power

Back in the 1950s, when the public was first becoming aware of the power of computers, the machines were often described as "electronic brains." Some people felt threatened by the implied comparison, but the truth is that brains are still more powerful than computers. Yet the metaphor may have been prophetic, for parallel processing, a new approach to developing faster, more capable computers, makes the old brain-computer analogy more apt.

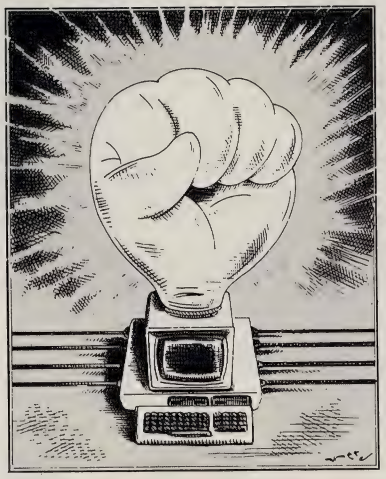
The human brain is nature's parallel processor: countless neuron networks communicate simultaneously, and we quickly store the tremendous amounts of data that enable us to see, hear, and think in real time. Traditional electronic brains are not so sophisticated. They operate serially, reading sequential bits and bytes with a single processor.

This time-honored approach dates back to the nineteenth century and Charles Babbage's mechanical "Analytical Engine," which worked on much the same principle, with one gear activating the next. In the 1930s, A. M. Turing conceived of a computer that processed symbols serially on an infinite strip of paper tape, changing its state according to the latest symbol in the series.

Near the end of World War II, Hungarian-American John von Neumann and colleagues developed the traditional serial architecture that underlies virtually all of today's computers, from massive mainframes to the micro in your home. It's true that on larger computers certain advanced techniques provide a degree of parallel operation. But basically, serial computers do one thing at a time, one after another.

Parallel processing, in several versions of "Non-von" architecture, may change all that. It's based on a simple principle: two microprocessors are better than one, four are better than two, and so on—up to perhaps 10,000 or more in the future. Instead of relying on one processor to solve a lengthy calculation, a computer with parallel architecture assigns portions of the problem to multiple processors operating simultaneously. In performing addition, for example, separate processors calculate subtotals and return them to a central unit for combining.

Parallel processing is beginning to answer the need for faster, smarter computers to perform complex tasks such as three-dimensional simulations of real-world events, seismic exploration, aerodynamic design, computer speech and vision, and problem solving with artificial intelligence. The technique, whose primary benefit is speed, shows great potential for tackling very large problems with multiple variables. It's not that you couldn't get the same answer with a serial machine; you just might not have the time to wait for it. If you're a fighter pilot, to use a graphic example, your interactive expert system had better talk fast.



Historically, we've increased computer speed and capacity by cramming more and faster devices onto smaller and smaller chips. But this approach does have limits. The sophisticated Cray-2, with a price tag of several million dollars, is a good example. Its components are so densely packed that they must be submerged in an inert liquid fluorocarbon coolant to reduce heat.

The Cray and almost all other "supercomputers" represent one parallel-processing design philosophy: linking a small number of expensive, state-of-the-art processors. The Cray-2 uses four, combining both parallel and serial processing. The ETA Systems GF-10, successor to Control Data's Cyber 205, will be marketed with eight processors in 1986. Denelcor's 16-processor HEP II will be available later this year.

Because of high cost, supercomputer use has been limited to government agencies and private industry. Only three or four universities have been able to purchase one. For that reason, most academic research has embraced a second philosophy: designing computers with a much larger number of relatively inexpensive, off-the-shelf microprocessors.

Such computers are less versatile than supercomputers, but they offer much of the same power at a fraction of the cost. The Cosmic Cube at the California Institute of Technology is a case in point. Future versions could ultimately approach the power of a super at a cost of thousands of dollars rather than millions.

Currently, the Cosmic Cube contains 64 Intel 8086 and 8087 chips in a crystal-like array. Each processor, or node, connects to six neighbors, much like a cubic lattice, and the nodes process in parallel. It's analogous, Cal Tech's Geoffrey Fox explains with tongue in cheek, to hiring 64 ordinary workers instead of a couple of expensive experts.

Fox, a theoretical physicist, says the Cube has completed a dozen problems and handles calculations requiring very long computation times quite efficiently. It has studied the formation of galaxies in the early universe, the melting of solids, and the motion of sand grains in dunes. The Cube worked for 2500 hours on the properties of fundamental particles. "With 64 nodes in parallel, that's equal to 160,000 hours of standard computing time," Fox points out. He says the machine will be expanded to 128 nodes and should soon become commercially available.

The Cube and other parallel computers have worked primarily on specialized problems, but Fox sees general-purpose applications as software becomes available. "Programming for ordinary machines has evolved for 30 years. Comparable progress for parallel processing will take a while—not 30 years, but perhaps 5 or 10."

Across the country at Columbia University, a second prototype of "Dado," with 1023 Intel 8751 processors, is nearing completion. Computer scientist Dr. Salvatore Stolfo, who sees a limit to speed increases with serial architecture, says that Dado is named for a portion of the base of a column. He hopes the machine will support a

ILLUSTRATION BY MICHAEL WITTE

"column" built with parallel architecture.

"The first Dado had 15 processors. It was a model airplane that proved the system would fly," Stolfo explains with a smile. "The current version is a larger model for the wind tunnel. It will have the capability to run large-scale, real-world applications." Specifically, Dado is designed to run expert systems. With a few modifications, it also will run speech recognition programs, Stolfo says. "The cabinet is no larger than a refrigerator. And with VLSI (very-large-scale integration), Dado would fit in a breadbox."

Stolfo sees parallel processing as a major turning point in computer history, with increasing marketplace activity during the next decade. "About 70 parallel machines are in the literature now. Many of them are capable of general-purpose applications that require an enormous number of calculations."

Indeed, the technology seems likely to filter down, perhaps even to the microcomputer level. Applications are already appearing beyond the rarified atmosphere of supercomputers. The DBC/1012 from Teradata Corp. in Los Angeles is a parallel machine for managing large databases. Six Intel 8086 processors (the machine will accommodate up to several hundred) are controlled by an intelligent bus that will redistribute the work if a processor or disk drive fails. Another parallel computer already earning its keep is IBM's Logic Simulation Machine in Los Gatos, California. It uses 63 parallel processors to simulate VLSI circuits, comparing complicated chip designs in seconds instead of hours.

A new chip created by NCR Corp. and Martin Marietta Aerospace uses 72 processors in parallel, and any number of these chips can be connected in parallel. Called a GAPP (Geometric Arithmetic Parallel Processor), the chip is designed for high-speed image processing in such applications as automated inspection and robot vision. The developers say GAPP is four or five times faster than much larger designs using conventional processing.

Despite these developments, current applications of parallel processing are still quite specialized. True general-purpose use awaits further developments in programming. "That's the most critical gap in our knowledge of parallel processing," says Dr. Robert H. Halstead Jr., assistant professor of computer science and engineering at MIT. "I hope parallel processing won't be confined just to specific uses. But we must do much better on programming." Scientists are working on a variety of interesting approaches, Halstead notes, but none has really been established beyond experimental applications.

ALTHOUGH it will be quite a few years before micros work like the human brain, parallel processing is a tentative step in that direction.

Halstead's computer, appropriately called Concert, should be completed sometime this spring. It will contain 32 Motorola 68000 processors. "It's not intended as a prototype," he explains. "It will be a test bed for experiments with parallel programming techniques. When we know more about those, we'll have a better idea of the hardware needed."

A single programming language is no more likely for parallel machines than for traditional computers. The reasons for diversity don't go away in the parallel world. You can write to the lowest common denominator and the program will run on a variety of multiprocessors. "It's a question of how much machine structure you hide and how much you leave visible in the language," Halstead says. Programs with fewer built-in machine specifics will be more transportable—but they'll probably also be less powerful. "We're trying to design languages that abstract the essence of parallel operation," says Halstead.

There's no timetable, but we certainly can expect new languages and devices tailored for parallel processing. For instance, a potentially revolutionary chip, programmable with a new language called Occam, is already on the market. The Transputer, developed by Inmos in Great Britain, is the first commercial device designed specifically for parallel processing. The VLSI chip contains a processor, memory, and communications circuitry and can be programmed in Occam for a variety of applications. Programs can be optimized on one chip then run unaltered on any number of Transputers sharing a parallel network. At London's Imperial College, Inmos Transputers use a parallel supercomputer that will run fifth-generation functional languages.

Parallel computers are here, although it will be quite a few years before microcomputers take on the characteristics of the human brain. But parallel processing seems a tentative step in that direction. Researchers at Carnegie-Mellon University envision a brain-like computer with memory distributed throughout a parallel network. Such a machine might be able to deal with concepts and generalizations. It also would, like the human brain, have built-in redundancy—if one processor (cell) were damaged, another would take over.

John von Neumann was himself quite familiar with parallel processing; he often related his "automata," or thinking machines, to nature's computers. But parallel processing just wasn't feasible with the large, power-hungry relays and vacuum tubes of the 1940s. The 1990s will be another story. Your new micro just might develop a split personality.

—ROBERT SWEARENGIN

Robert Swearengin is a contributing editor of *Popular Computing.*

The Resurrection of PCjr

Dramatic price cuts warrant a second look at this controversial machine

When the volume of my mail jumps by a factor of 10, I know something I've written has struck a nerve. Apparently, my story on "The Life and Times of PCjr" (which ran in the January 1985 issue of *Popular Computing*) hit an especially raw nerve:

Dear Mr. Levy:
I have just recently purchased an IBM PCjr. I think your article about Jr's fate was in poor taste. You were looking for faults, not good points. You jumped ahead with the expansion, etc., whereas normal buyers would wait months, maybe years, maybe never, before they expanded their computers. You are an experienced computer user. Those who buy Jr for a simple home computer are not. When you insulted Jr, you insulted me. I love my little PC . . . Please be a little more kind to those of us who buy things you don't like.
—Mike Gilvary, Fair Haven, NJ

Mike Gilvary is only one of many who felt compelled to respond to my article, and he likewise is only one of many who purchased the machine that heralded IBM's controversial entry into the home computer market. This level of customer support is impressive. As it turns out, from the time I wrote that article to the time it was published, some significant events occurred in the already action-packed existence of that amazing computer.

So at the risk of beating a subject to death, I hereby reconvene the discussion of the IBM PCjr.

First, some background. My article last January ran, to the apparent astonishment of some of its critics, for nine pages and included some playful photos of my attempts to cope with the PCjr's alleged inadequacies. I discussed the history of the machine—its status as a legend even before its introduction, its severe limitations, its treatment by the press and analysts, its rejection by consumers, its eventual "enhancement." I also recounted some of my hands-on experience, which spanned over eight months of having the machine in my office.

There was a fair amount of analysis to tie this information together, and the PCjr did not stand up particularly well to that analysis. Though I took pains to present my arguments fairly, my conclusion was that the PCjr, enhanced or not, was an inferior, unnecessarily difficult-to-use machine, far less successful than we would have expected from its powerful manufacturer; and that the fate of this computer would have far-reaching implications for the computer revolution itself. Then in a remark that apparently captured the imagination of both critics and supporters of the article, I opined that the PCjr "has the smell of death about it."

Though the article was a departure from a standard hardware review, and the PCjr was certainly a machine people like to read about, I was taken aback at the breadth and intensity of the response to the piece. I received reactions by paper mail, by electronic mail, by chance meetings with both strangers and acquaintances, and by published citation. By way of the latter, the article was quoted in the *Wall Street Journal* and *Time*, which picked up on the "smell of death" remark.

"Brain Damaged?"

IBM itself even felt compelled to respond; a letter describing the corporate reaction as one of "bewilder-

Steven Levy is a contributing editor of *Popular Computing.*

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ment" arrived at *Popular Computing* over the signature of James C. Reilly, the Vice President of Communications and Marketing Services of IBM's Entry Systems Division. Charging that I failed to "measure up to accepted standards of journalistic performance" and alleging "numerous misrepresentations," Mr. Reilly culminated his objection by saying that IBM was "dismayed by Mr. Levy's unseemly, insensitive use of such analogies as 'brain damaged' in an attempt to be amusing."

I'll get to the notorious "brain damaged" remark later. Let it be noted that when I called IBM to tell them of this follow-up column and offer them a chance to actually cite some of these "misrepresentations," their representative (who was, as were all IBM people I have dealt with professionally, cordial and efficient) said that IBM would prefer to stand by the letter. So, pending a new definition of "accepted journalistic performance" by IBM, I will stand by my story.

However, times change quickly in the computer world. While I stick to my contention that the PCjr is a cumbersome kludge, I'm afraid I do have to modify my implicit conclusion that Jr is not a machine worth buying. Here's why:

Dear Mr. Levy:
My local Computerland store is now selling the Jr with DOS 2.1 and the color monitor for under $1000. This effectively gives the Jr alone with 128K and a disk drive a price of $510, and I suspect that to sweeten the "deal" other dealers will be throwing in a few "extras" as well. Certainly I agree with you that the Jr isn't a full-price IBM PC, but when you look at what you get for the price . . . the PCjr looks like a very good little machine. —*Tom Loffman, Sacramento, CA*

Mr. Loffman's letter captures the key development in the history of PCjr that turned the tables on my "smell of death" statement: IBM's drastic price reductions. When I wrote the article, a standard PCjr setup of one-drive 128K computer, color monitor, DOS 2.1, and BASIC cartridge listed for around $1600, and discounts were not deep.

After I finished the article, IBM's pre-Christmas discounts resulted in dealers widely selling that same package for, as Mr. Loffman notes, well under $1000. In New York City, for instance, you could get that entire package for around $900, with some places offering the bundle at $800. In effect you were getting a discount on the Jr, the software free, and the color monitor tossed in to boot!

"Economic Perfume"

It was a whole new ball game. And consumers reacted appropriately. While properly snubbing even the "enhanced" PCjr at its original pricing, they bought thousands of PCjrs at the bargain-basement rate. In many stores, the PCjr outsold the expected champion, the Apple IIc. Some magazines and newspapers ran stories on what they called the spectacular recovery of the PCjr—the *Time* story was headlined "A Flop Becomes A Hit." The *Wall Street Journal* item was called "IBM's PCjr Computer Is Fulfilling Its Promise After A Faltering Start."

But was it really fulfilling its promise? Of course not. If it were, IBM would not have had to slash the price by more than half in less than one year. Careful readers of my story might have noted that I qualifed my prediction of low PCjr sales by saying that it could be different if "IBM cut the price hundreds of dollars" and sold it through K Mart. That particular retailer did not become an official IBM dealer, but the price was indeed effectively cut by hundreds of dollars.

Also, I submit that there was no egg on the face of another, more biased doomsayer, Apple Chairman Steve Jobs. In June 1984, when he addressed a Future Computing seminar in San Francisco, Subtle Steve gave the following evaluation of the Jr: "It is now a tainted product. It will never be a great product . . . What IBM should do is just apologize for introducing the PCjr, recall them all, and throw them in the Hudson River."

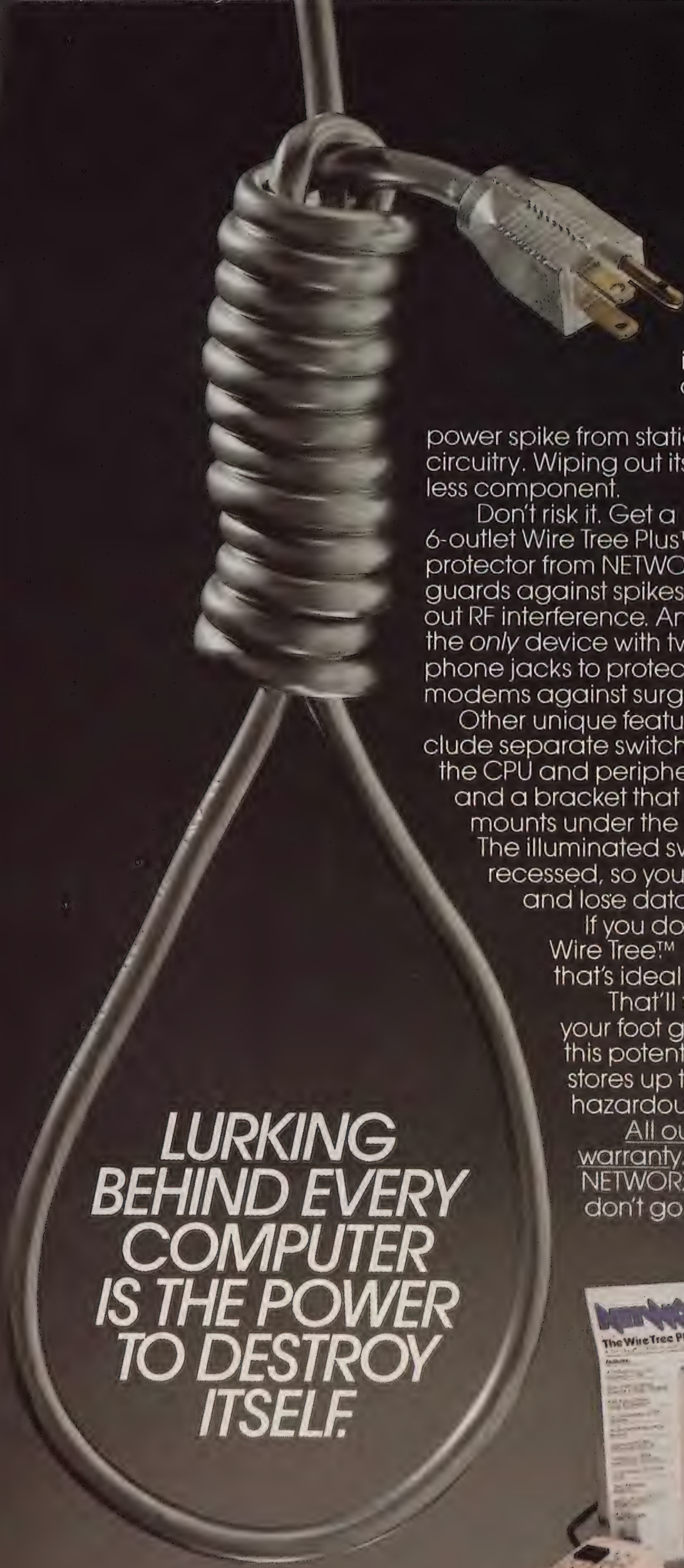
Even this does not look silly in retrospect when you consider that he went on to say, "That's what they should do, but they won't because their manhood is at stake . . . The question is will they be able to reach those . . . people [who buy home computers]? My answer is 'Not unless they shove their products down customers' throats.' "

Leaving aside the possible motive of preserving corporate manhood, I think that a case can be made that the "success" of the PCjr was indeed made by a nonviolent form of "shoving the product down customers' throats" in the form of a major advertising blitz. By my conservative calculations, IBM spent over $100 in advertising for each PCjr it sold. Of course, the potential customer has the option of spitting out what is shoved—but the sugarcoated price was incentive enough for many to swallow. To put it another way, IBM dealt with the "smell of death" by a strong dose of economic perfume. At $800 with color monitor included, the PCjr didn't smell so bad after all.

Hard Feelings

Dear Steve Levy:
I am sure glad that I am not a relative of yours! I would hate to be your son . . . To call this article an unfair slander of the IBM PCjr would be too nice . . . It seems you spent more time trying to think of ways to tear this machine down than you did researching the product . . . Just what is your problem anyway? You even decided to attack the disk operating system version 2.1 . . . Just because you get confused between the difference of drive A and drive B does not mean that everyone does. It just requires you to think a little bit. Maybe that was asking too much of you! You seem bent on driving IBM into the ground every chance you get. Don't you care about the readers of your magazine? —*Eric R. Skjeie, Cornelius, OR*

As these letter writers demonstrate, feelings get intense when someone bad-mouths a machine you have paid your hard-earned cash for. So let me assure all you people who bought PCjr color systems for $900 or less that I think you made a decent buy. Your alternatives were Commodore, Atari, and the now-dis-



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Inquiry 46

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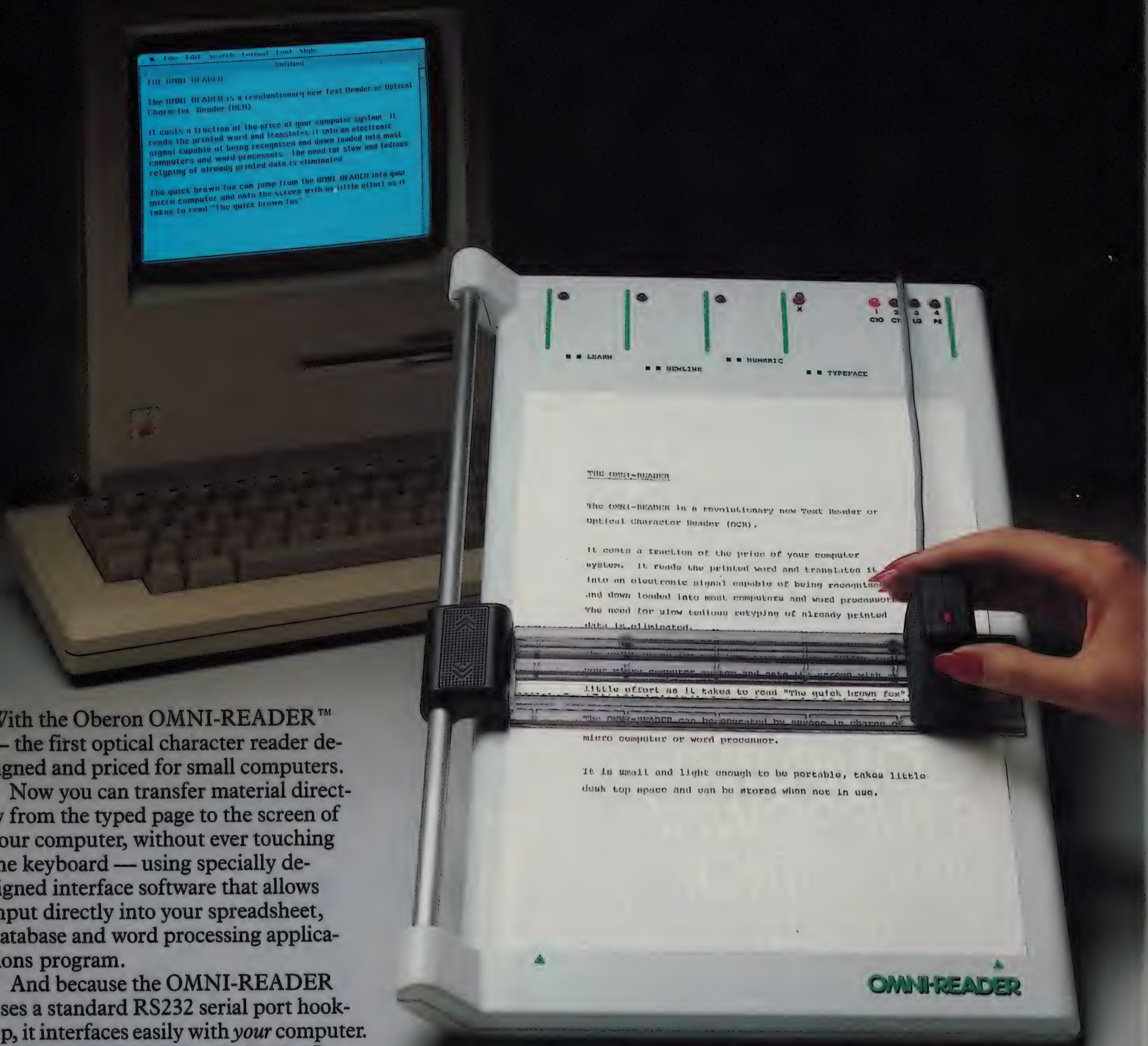

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Inquiry 48

continued Adam system, and of those the PCjr is the most powerful and certainly the one that allows you to perform the most tasks. Learning how to use a PCjr is not particularly easy, and PCjr owners will have to put up with certain annoyances for the duration of their ownership, but these are sacrifices one makes when buying computers on a budget. Money changes everything.

Some people are now actually enthusiastic about the PCjr. Not long after the article was published, I got a call from Bob Albrecht, the gregarious founder of the legendary Peoples Computer Company, a man who has been deeply involved in educational computing for over two decades. "Levy, you blew it," he howled. "PCjr BASIC is the most powerful BASIC available. The Junior is *the* computer for the next two years!"

I wondered why that powerful BASIC was not included in the machine's ROM (as are a useless version of cassette-tape BASIC and a dumb program called Keyboard Adventure), but Albrecht was unfazed, insisting that great software specifically written for the PCjr, taking advantage of the machine's fine sound and graphics capabilities, was "on the way." But at the recent Consumer Electronics Show, little of this software was available, and the developers I talked to said that instead of writing PCjr-specific software, they would write programs that worked on both the PC and the PCjr—thus bypassing the audiovisual advantages that Albrecht was referring to.

Of course, Junior's ability to run much (but a far cry from all) of the extensive PC software base is a compelling factor in PCjr's favor. And the few programs that IBM has helped modify for the machine, notably 1-2-3, PCjr Colorpaint, the game King's Quest, and Andrew Tobias's Managing Your Money, all work excellently. Stewart Brand of the *Whole Earth Software Catalog* recently asserted to me that the latter program alone could stand as a justification for buying a PCjr. While I am not familiar enough with the program to make that statement, I will say that the number of MS-DOS programs that run on the computer make it a sufficient engine to do some real work, once you learn how the machine works. I never said otherwise.

Judgments, Pro and Con

Other letter writers, such as Bruce Galvin of Seattle, went even further and complained about the very act of evaluating the chances of a machine's success. "It is fine to criticize some of the machine's shortcomings," wrote Bruce, "but it is not right to make *judgments* [his italics] about a machine's future."

I think it *is* precisely my responsibility—and I doubt that even IBM would say this violates "accepted standards of journalistic practice"—to inform my readers not only of the advantages and disadvantages of a given machine, but to venture an educated guess on the future of that machine, a not insignificant factor considering recent history.

Even though sales of the PCjr have rallied, and the machine has become a good buy compared to the competition, I cannot say that this situation will continue. Other machines at similar prices (for instance, the soon-to-be-released Commodore-Amiga computer and the new Atari ST computers, which promise huge computing power for incredibly low cost) have yet to be evaluated. Apple II prices may drop to PCjr levels. IBM may replace PCjr with a different home machine.

Even though many of us who write about computers have our favorite companies or machines, we put those factors aside when we write; our credibility is on the line. While some of the letters I have included in this column respectfully or disrespectfully disagree with my judgment, the personal response to the story I received in January, when I attended the Winter CES show, was overwhelmingly positive. Apparently, many journalists, third-party software developers, and industry observers agreed with my point of view. And while some of my letter-writing critics might have been too incensed to notice it, I did include a fair amount of information to back up my claims.

But as IBM's James C. Reilly points out, there was also an "attempt to be amusing" in the article. Guilty as charged, I guess; why attempt to be morose when discussing "The Life and Times of the PCjr," a story that I still insist is as amusing as one may find in the industry today? Specifically, he objects to the "insensitive" use of the words "brain damaged," and indeed, IBM was moved to send a separate, more cutting, letter to the *Detroit News*, which ran a column about my article with the headline "IBM PCjr Called Brain Damaged."

I did use those words in the story. In fact, they were printed as a complete sentence, with an exclamation point. But those who refer back to the piece will see that "brain damaged" was used not to characterize the overall machine, but to describe my reaction to the fact that, on Jr's first release, even a medium-speed typist using the dread "Chiclet" keyboard could easily outtype Homeword, the semiofficial PCjr word-processing program.

Computer historians will note that the term "brain damaged" has an illustrious history. As far as I know, it was first used (as computer jargon) by hackers at MIT in describing a complicated operating system called Multics. The term was later used generically as an insult given to any particularly inelegant facet of computerdom, particularly those whose conception was muddled by layers of bureaucracy.

I think the term fits nicely into a piece about the PCjr, a bad idea salvaged by unwieldy enhancements and made viable by drastic price cutting.

Dear Editor, Popular Computing:

My first comment: Please cancel my subscription . . . And my second comment: Who the hell is Steven Levy?

—Alan C. Scott, Salem, OR □

Steven Levy welcomes your comments and suggestions. You can contact him on The Source (ID TCT670) or Compuserve (ID 72065, 635) or by writing to him c/o *Popular Computing*, POB 397, Hancock, NH 03449.

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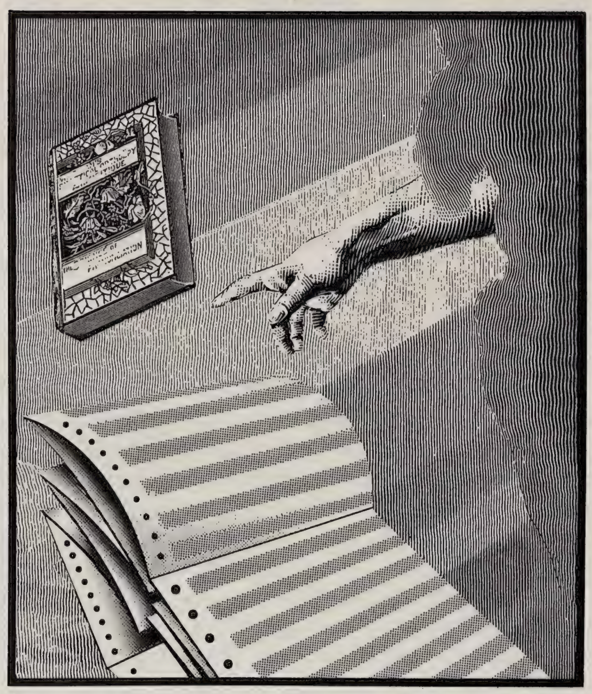
Inquiry 38

MICRO REVOLUTION
BY JERRY POURNELLE

The Literacy Game

Whether it's operating a computer or knowing how to read and write, we're all striving for literacy



In his 1983 maiden speech Senator Frank Lautenberg (D., New Jersey) told the U.S. Senate that "the concept of computer literacy defines a new kind of illiteracy and the potential for new and distressing divisions in our society. Computers are proliferating more rapidly in homes and schools in wealthy districts, leaving the poor to become illiterate in this new technology."

Lautenberg isn't alone in worrying about what computers will do to the poor. I recall a few years ago walking out of my own science fiction discussion panel because several fans insisted on changing the subject to one I had long since wearied of: the terrible things widespread use of small computers would do to the poor. "Elitism," they cried.

Lautenberg ought to know better. He made so much money with his Automatic Data Processing Company that he could afford to spend upwards of $3 million of his own to win his Senate seat; surely he knows something of computers? But perhaps not. Automatic Data Processing was a company built in the days when computers really were available only to an elite. In those days one needed either great expertise or great wealth to get any direct access to a computer.

The Old Days

In 1966 IBM donated a large mainframe computer—a System 360 as I recall—to the University of California at Los Angeles on the condition that UCLA make time available to the other colleges and universities in the LA area. UCLA accordingly sent around notices telling the various schools how to go about obtaining their share of the reserved time.

Since the time couldn't be used for administrative stuff like payrolls, most of the small colleges hadn't the foggiest notion of what to do with it. When the notice came to Pepperdine it would have been thrown away if a secretary in the president's office hadn't remembered that I'd once "done something with computers" and routed it to me.

I was at that time a professor of political science. I had zero need for computer time—but I sure wasn't going to let that opportunity go to waste. I quickly ginned up a course in simulation and modeling. Even the offer of computer experience wasn't enough to get more than three students to sign up, but that was just as well: Pepperdine in those days wasn't as well off as it is now, and my simulations course had to be added to an already too heavy teaching load.

For that matter, I hadn't any idea of how to use the machine. My previous experience with computers had been in 1965, when I wrote machine-code routines for the University of Washington's IBM 650. A few years later when I was developing simulation models for the Air Force, the machines ran FORTRAN, but I didn't have to learn it. The Aerospace Corporation had a large central computing facility ably commanded by Dr. Allan Callendar, and when I wanted something evaluated, one of his nice young programmers would show up, write down my equations, and go away; presently the answers would appear like magic.

Thus my new course was the blind leading the blind. I knew little. My students knew nothing. Even so, we managed. I took them over to

Science fiction writer Jerry Pournelle, who joined the micro revolution eight years ago, is a contributing editor of *Popular Computing.*

Illustration by Mark Yankus

UCLA and showed them how to use the various card-processing equipment. That fortunately hadn't changed since my University of Washington days. We got the IBM FORTRAN manuals and what books we could find on the subject. One of the students quickly became a computer fanatic and soon learned more than the rest of us combined, becoming in effect the actual teacher. He even learned to cope with the dreaded Format statement. By the end of the year we had not only managed to write some programs that actually ran but even to publish some of the results.

In those days there was only the one computer for the entire Los Angeles collegiate community, and none of us ever saw it. When we wanted to use the computer we had first to design the program; then write it; then keypunch it onto cards. We would then take the program deck, top it with a "job control" card giving our budget and authorization number, and carry it to the computer laboratory.

Long before gaining sight of the computer we were stopped by a dutch door. To submit a program we would stand at the door until someone inside noticed us and took our box of cards, often without speaking to us. We'd then go away. Next day we'd return and look through a stack of computer card boxes until we found ours.

Cryptic Error Messages

If we were lucky, we'd have our answers. Usually, though, we'd have no answers, merely a stack of long green-and-white paper with cryptic error messages telling us why our program wouldn't compile or, having compiled, why it wouldn't run. We'd go through that until the program ran properly, a process that might take weeks. Eventually, though, things would work. My students and I became reasonably proficient in elementary FORTRAN. We had some idea of what computers could do, but even after a year's work you could hardly call us "computer literate."

That's all changed. Nowadays there sits on my desk a machine capable of doing a lot more than anything I imagined a computer could do in those days. Back then we thought a 20-variable simulation was pretty complex; now I have Jay Forrester's "World Dynamics" model in BASIC. It has over 20 nonlinear variables, and I can change relationships, add more variables, and generally experiment with it. When I tire of that, I can use my computer to write science fiction, and when I'm not using the machine, the kids can use it for homework or to play games.

I'VE never met anyone who can tell me what "computer literacy" means, but we're willing to spend whatever it takes to get it.

How is this elitist? Back in the System 360 days getting time on a computer was tough. It didn't so much take money—Pepperdine wasn't rich, and certainly my students weren't—but it did take grim determination. Even then you got no access to the machine.

For all my efforts in the '60's I learned so little about computers that in effect I had to start over when micros became available. Now there are a lot of machines around. One doesn't need much more than desire. Truly, anyone who genuinely wants to can get access to enough computing power to get more familiarity with computers than ever I managed. Getting computer literacy may not be simple, but it's denied to no one—or is it?

What Is Computer Literacy?

"Computer literacy" has become the big buzz concept of the year. Teaching this elusive skill is thought to be one of the major tasks facing education today. A Los Angeles County Schools task force is seeking ways to teach computer skills and use computers in education. Publishing firms have leaped into the act. Armies of consultants have appeared. Computer illiteracy threatens to divide our people. A crisis looms. Yet help is at hand. A U.S. Senator thinks the topic so important that he makes it the subject of his maiden speech. Surely we in the United States will rise to meet this need. We can afford it, and we certainly do not want any more divisions. We must be ready to spend whatever it takes to obtain computer literacy for all.

The fascinating part is that I've never met anyone who can tell me what the term means. We'll spend whatever it takes to get it, but we don't know what we're buying.

The Real Problem

During World War II it was found that the application of mathematical theories to the way weapons were employed could have dramatic consequences. One of the classic cases arose from the aircraft/submarine duels; the mathematicians were able to increase aircraft effectiveness by several hundred percent and had a significant effect on the outcome of the Battle of the Atlantic.

From this arose the discipline known as operations research (OR). After the war OR techniques were applied to industry with considerable success. Then OR was expanded into a nebulous "science" known as "Systems Analysis" and hyped as the solution to all human problems. Belief in the efficacy of Systems Analysis for everything from weapons design to the conduct of guerrilla warfare gave OR something of a diminished reputation. That conclusion is a pity, because operation analysis techniques can be useful, if for no other reason than that the first principle of OR is that there must be an explicitly definable goal or criterion. If you can't define precisely what it is you want, you can't find the best way to get it.

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Moreover, the search for ways to *define* your goals often leads you to wonder whether those are the goals you really want.

As an example: do we, as a nation, really care about "computer literacy"? I'd think we do not, that computer literacy is no more desirable, as such, than literacy in Urdu or Amharic. What we really want is for all our children to have a reasonable chance at successful participation in modern society. An ability effectively to use computers is probably going to be important for success, and therefore we ought to be sure young people have a chance to learn computer skills; but that's not quite the same thing as teaching "computer literacy."

Prerequisites

Basic computer skills can be important, but no more so than some others. For example, we want everyone to be able to use the telephone. It turns out, though, that we don't need formal instruction in "telephone literacy" but we do need some prerequisite skills, such as the ability to recognize and remember numbers. I often wonder if it isn't the same with computers: give kids some prerequisite skills, and they'll pick up computer literacy on their own.

Analyzing the prerequisites isn't easy. In trying to think of examples the first I hit on was typing. It's obvious that knowing how to type makes it much easier to operate a computer, and indeed those who can't type in today's society are at a great disadvantage; the days when knowing how to type doomed you to a lower-level job are long gone. Executives use computers directly for the same reason that they dial many of their own telephone calls: it's more efficient. However, typing skill is not prerequisite to computer literacy, and once you have access to a computer, learning to type is as simple as playing one of the many "learn to type" games, such as Type Attack.

Indeed, my analysis leads me to an unexpected conclusion: computer literacy doesn't have many prerequisites beyond access to a computer and the desire to learn. However, there is one skill that is prerequisite to nearly everything.

The real problem with American society is that a great number of children get out of school without learning any kind of literacy. I submit that illiteracy in English is far more damaging than computer illiteracy—and that a school system that can't teach kids how to read and write isn't likely to have superior results in teaching them to use computers.

> **BEING unable to read is much worse than being unable to operate a computer—and you can't learn much about computers until you can read.**

Of course, the education establishment has plenty of explanations for why the kids can't read. The kids have home conflicts. Kids "have" reading disabilities or "have" dyslexia. The classes are too large. Teachers are underpaid.

However, if we'll only give the education establishment enough money, all problems will go away. The kids will all learn to read and write, then they'll all become computer literate, and the Republic will be safe forever. The only problem is that we tried that. Schools now get more money per pupil than ever they did when I was a youngster—but the literacy rate isn't any better. In most states it's far worse.

About a quarter of all American kids will learn to read no matter what method is used to teach them—indeed, will probably pick it up without any kind of instruction. Another quarter will learn so long as the teacher isn't actively fighting the process. Nearly *anyone* can teach about half the kids to read. No special training is required. After that things get tougher. Teaching the last 20% or so is hard work. It's easy to find excuses for failure if that's what you've been taught to look for.

Before we get concerned about computer illiteracy creating "new and distressing divisions in our society," we ought to worry a lot more about what the old-fashioned kind of illiteracy has done to us. Being unable to read is much worse than being unable to operate a computer—and anyway you'll never learn much about using computers until you can read. The best way to see that the next generation has computer skills is to see that everyone can read and write.

There Is Hope

Far from causing a new form of illiteracy, computers will help cure the old kind. Roberta Pournelle teaches reading in a detention center for teenagers. Most of her students are illiterate. Many are accompanied by pounds of psychological analyses proving that the kid can't possibly learn to read. She ignores that and teaches them. Her methods, most of which involve phonics, are being incorporated into a computer program designed to let any literate person teach others to read. The nice part is that anyone taught that way will automatically acquire computer literacy as a bonus.

If Senator Lautenberg is really concerned about illiteracy, he should support Georgia Congressman Newt Gingrich's bill to give tax credits to any family that buys a home computer. He could also work on making the IRS change its weird new rules about computer deductibility. Computers are fun. If you want kids to learn about them, stop putting obstacles in the way of computer access. Make it easy to get at computers, and get out of the way. The kids will do the rest, and it won't look like elitism at all. □

Jerry Pournelle welcomes comments from members of the micro revolution. Write to him c/o *Popular Computing*, POB 397, Hancock, NH 03449. Jerry tries to answer all his mail but cannot promise individual replies.

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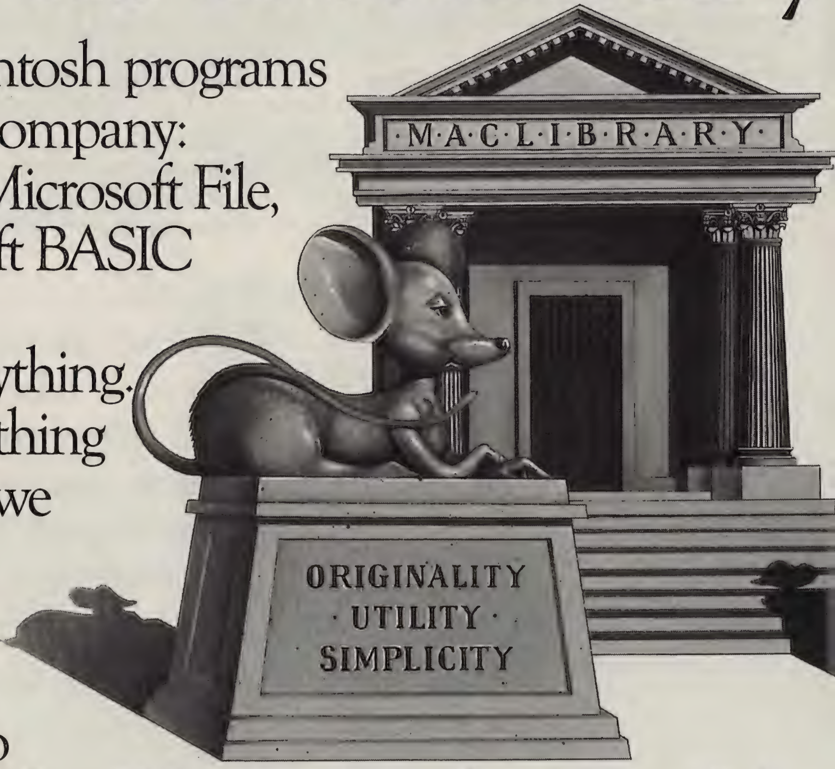


Every program has to sweat out an interview.

Because we've begun to build up an impressive body of Macintosh work, we founded Microsoft MacLibrary™ programs to house them.

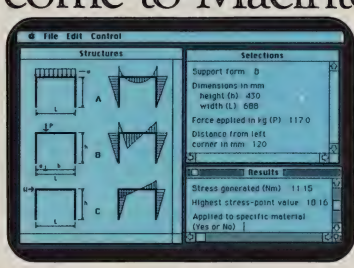
Programs for business, for learning, for fun.

And these disks can't just roll in off the street. Each program has been exhaustively reviewed, previewed, and scrutinized.

We look for highly original, highly useful programs that are easy to learn and use.

Our first releases.

The renowned programming language, Logo, has now come to Macintosh. A mainstay of university curriculums,



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Logo teaches programming concepts, techniques, and problem solving strategies. And it makes it all fun to boot. Intriguing enough to challenge even an advanced programmer —or motivate a child—this is Logo's latest

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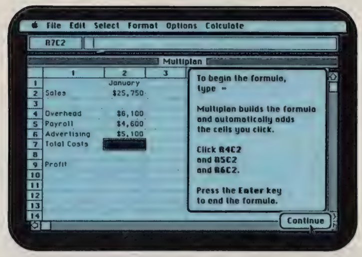
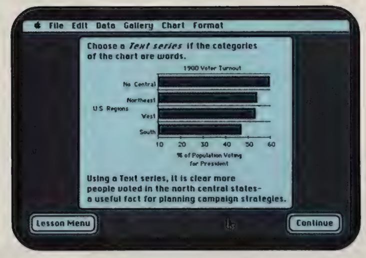
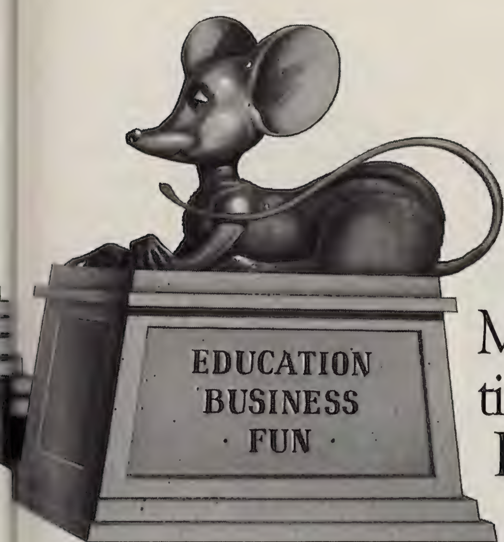



Learning Microsoft Multiplan® and Microsoft Chart by Micro Courseware Corp.



Learning Microsoft Multiplan and Microsoft Chart is a superb interactive instructional program by Micro Courseware Corp. It walks you through the basics and into the intricacies of these sophisticated business tools. Teach yourself quickly and simply how to produce presentation quality graphics. As well as what-if projections, portfolio managers, and financial models.

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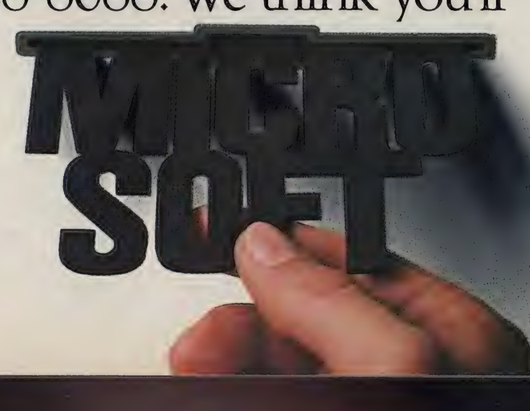
For a list of your nearest dealer stocking MacLibrary software, just call (800) 426-9400. Or in Washington State, Alaska, Hawaii and Canada, call (206) 828-8088. We think you'll be impressed. Because making it into MacLibrary speaks volumes.



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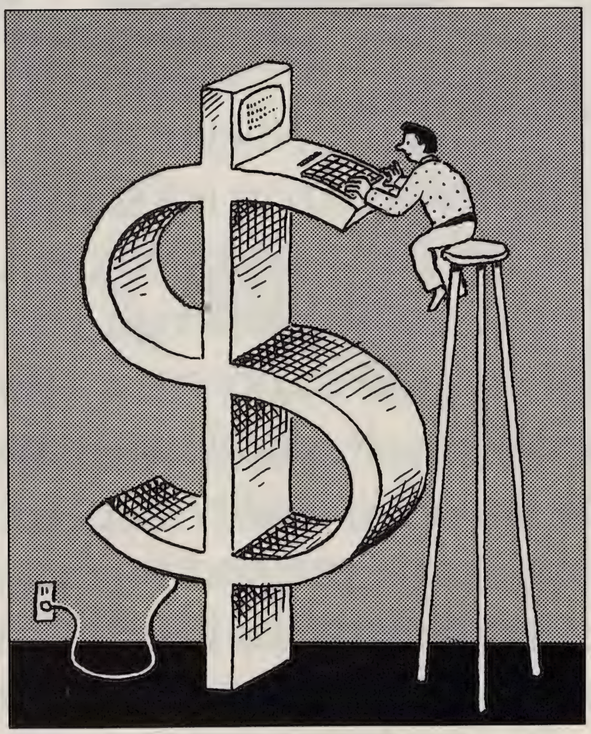
BY MICHAEL J. MILLER

Computers Aren't Cheap

But, all things considered, they're not a bad deal



Every week I hear people say they're waiting for prices to go down before they buy a personal computer. Call me the resident skeptic, but I have some advice for these people: don't hold your breath.

We grudgingly accept rising prices for housing, food, and fuel—in fact, we're surprised when prices even stay the same. But we have different expectations for electronics. After all, it took only a couple of years for the price of a simple handheld, four-function calculator to drop from several hundred dollars to less than $10. And videocassette recorders that sold for $1000 in 1982 now go for less than $300.

Home computers that are used primarily for games have also dropped in price, but the standard business personal computers made by IBM, Compaq, Apple, Tandy, and others are still pricey items. And despite the hopes of many, they're likely to remain that way.

It's true that some microcomputer prices have fallen. While an Apple IIe cost $1395 just two years ago, the base unit was recently advertised for as little as $588. In less than a year, the street price of a Macintosh fell from $2495 to under $1500. And last Christmas several dealers sold the PCjr—with a 16-bit processor, 128K bytes of user memory, software, not one but two keyboards, *and a color monitor*—for less than $900, about half of what it was selling for at its introduction a year ago.

But these price cuts are nothing compared to the slashes on calculators, VCRs, and low-end home computers.

It's too easy to brush aside the question of microcomputer prices with casual remarks about how today's microcomputers are more powerful than the million-dollar mainframes of 20 years ago. Instead, we should ask a basic question: why do computers cost so much?

Add It Up

Many factors determine the price of a computer. You have to consider what the manufacturer is paying to suppliers for components, what it invests in marketing, distribution, research and development, and sales, and, of course, what it expects as profit. For an example of component costs, let's look at typical prices of the standard parts found in the equivalent of an IBM PC XT.

The main electronic component (called the motherboard) with 64K bytes of RAM costs $200 to $300. An additional 192K bytes of RAM costs $60 to $70. Add $80 for the keyboard, $100 for the power supply, $40 for the floppy-disk drive, $300 for the 10-megabyte hard disk, and $130 for the hard-disk controller. The total is just about $1000. Now toss in marketing expenses and a little bit of profit (let's say 35 percent), and you'd expect that this machine would sell for about $1600, right? Wrong. The PC XT routinely sells for $3500.

Among computer system manufacturers, you often hear about a "3-to-1 ratio"—multiply the manufacturing cost by three to get the retail cost.

In a typical situation, the retail price breaks down to about a third for manufacturing costs, a third for the dealer's markup, and another third to cover such things as marketing, administration, research and development, and (oh, yes) profit. You might even have a hard time convincing dealers to take a product

Michael J. Miller is a West Coast editor of *Popular Computing*.

ILLUSTRATION BY MICHAEL BARTALOS

Fast Cash For Your Slow Modem.

During Hayes Modem Trade-Up Days Now through April 30, 1985

If your old modem is costing you too much in time and telephone charges, now's the time to trade up to the industry leader—Hayes Smartmodem 1200™ (operates with the IBM® PC and many other personal computers, including Macintosh™) and Hayes Smartmodem 1200B™ (plug-in board modem for the IBM PC and compatibles).

Cash saving rebate.* During Hayes Modem Trade-Up Days, bring in your old modem (any speed, any make) to a participating dealer. And Hayes will send you a cash rebate when you purchase a new Smartmodem 1200. If your used modem is a Hayes, we'll send you $50; if it's some other brand, we'll send you $25. It's that simple.

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Get on-line with the leader. Don't miss this special opportunity to dramatically increase the speed and performance of your communications. While cashing in on some great savings from Hayes, the telecomputing leader.

Call right away for the name of your nearest participating dealer. And get fast cash for *your* slow modem.

1-800-255-2550 (In the Continental U.S.). (Call 1-800-447-0890 in Alaska and Hawaii). Remember. Our modem trade-up offer is only good through April 30th. So call today.

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***The promotion is available only through participating dealers in the U.S. and Canada. Please allow 4 to 6 weeks delivery for rebate check.** Smartmodem 1200 and Smartmodem 1200B are trademarks of Hayes Microcomputer Products, Inc. Macintosh is a trademark of Apple Computer Inc. IBM is a trademark of International Business Machines Corp. ©1985 Hayes Microcomputer Products, Inc.

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PC-Draw Will Increase Your Office Productivity. And Upward Mobility.

Imagine. You now have the capability to graphically depict your best ideas, plans, designs and proposals. *In color or black & white*. Accurately. Completely. Dramatically. Concepts presented so forcefully—yet so simply—that you leave that critical meeting with upper management... *totally* confident of success.

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And you win. Your secret weapon? PC-Draw. A powerful interactive graphics program for the IBM PC or XT™—*unlike anything else* on the market. Using PC-Draw you create virtually anything that can be drawn with pencil and paper. Quickly. Easily. With far greater detail.

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PC-Draw includes an *easy-to-follow* interactive tutorial. Requires IBM PC or XT™ or compatible, graphics adapter and graphics monitor. Version for PCjr available. Graphic boards, plotters at competitive prices.

Shhh! Don't tell your office competition about PC-Draw. They'll catch on soon enough. For free brochure or to order call 214/234-1999. In Texas or for customer service call 214/234-1769. Micrografx, Inc., 1701 N. Greenville Ave., Suite 305, Richardson, Texas 75081.

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Inquiry 42

with such a small markup.

Facing numbers like these, you may well be tempted to build a computer for yourself. Though you will pay more for the parts for a single computer than system manufacturers do, you could still save a fair amount of pocket change. In fact, with enough patience, you can build a computer (or at least add on to one) for less money than you can buy it, something you can't do with calculators or VCRs. While this task isn't as simple as assembling a tricycle for your 5-year-old on Christmas Eve, it's not all that difficult.

Do-it-yourself savings are even more obvious when you look at the price of system add-ons. For instance, from a mail-order company you can get a 10-megabyte hard disk for about $800. Yet some manufacturers continue to charge a $1500 to $2000 premium for their hard-disk machines even though their added cost is only $300 or $400 and the supplier's manufacturing cost is even less (probably about $200). Similarly, an extra 64K bytes of memory from a manufacturer carries a suggested retail price of about $100, but it costs only about $40 from a discount house.

You may not want to go this route, of course—particularly for an entire computer. You might leave out a screw or two or bend a prong on a RAM chip. And you won't have the service network and support of established manufacturers.

More Than Parts Alone

Less obvious considerations also add to the price of microcomputers. Sheer volume cuts manufacturing costs and partially explains why home computers go for lower prices than business computers. Although we may think of IBM and Apple as the major microcomputer manufacturers, they sell far fewer units than do Commodore and Atari. Moreover, business computer suppliers purchase almost all their parts from other firms, while low-end home computer makers do more of their own manufacturing.

Dealer margins for business computers remain fairly high simply because the cost of selling microcomputers remains high. Customers demand more support from computer dealers than from stores that sell VCRs or calculators. Furthermore, the costs of using distributors, maintaining dealer and service networks, and supporting marketing and research and development also drive up the price of business computers.

The initial retail price is often set in an arbitrary fashion, though it usually settles to about three times the manufacturing cost. Not until after the product is designed and ready for the stores do the marketing, product development, advertising, and sales people get together to determine a suggested retail price. This is a complicated decision. If manufacturers set prices too high, they'll scare off many customers; if they set them too low, customers won't take the new products seriously.

> **PRICES won't drop quickly. But you can expect an improved price/performance ratio thanks to advances in technology.**

Manufacturers being human, a certain amount of greed also enters the equation, as does the idea that a price should be high enough to sustain a cut later. (That's why some "discounts" look so attractive.) Manufacturers also have to consider the impact of prices on the other products they sell—if the IBM PC AT were priced about the same as the less powerful PC, would you even consider the older machine?

Who Cares?

All of these fairly tangible factors contribute to high prices. But another observable phenomenon also helps to keep prices inflated: too many customers simply don't care.

Most of the machines we're talking about are used in the business world, where the return on investment in terms of time saved quickly pays for the personal computers. If a $3000 computer saves a lawyer two hours of work a week at $100 an hour, it pays for itself in less than four months. And on top of that, the investment is tax-deductible.

Individuals care about the price of microcomputers, but to a large extent General Motors doesn't. (It already gets a sizable discount for bulk purchases.) With corporate and business sales accounting for such a large share of the market, it's little wonder that so many manufacturers are in no big hurry to cut prices.

Computer prices won't drop fast, but you can expect a gradual decline. Technological and manufacturing advances have improved performance at the same time they have reduced the prices of components such as computer memory and liquid crystal display screens. As a result, you can expect increased performance at the same cost.

The high-volume mass-market computers—those that are perceived primarily as game machines—are now entrenched at less than $200. Machines with disk drives, monitors, and printers cost from $1000 to $1500 (the Apple IIc, IBM PCjr, and the new machines from Atari and Commodore, for instance). At the business level, where we often see lots of RAM, dual disk drives, better printers, and graphics capabilities, the $2500-to-$3000 system is quite common. Average system prices may even edge up slightly if hard disks gain the popularity they deserve.

So while we'll undoubtedly get more for our money in the not-too-distant future, the day when full-blown business computers cost less than $1000 seems a long way off. That's not all bad news. After all, many firms and individuals have already discovered that computers are a terrific investment at today's prices, and that's what counts. □

Texas Instruments announces Dr. L.S. Montejo Professional

*Dr. L.S. Montejo,
Cardiac Anesthesiologist,
Boston, Massachusetts.*

the Computing System.

No two individuals work alike. TI had unique answers to help Dr. L. S. Montejo keep his patients and his business healthy.

"I used to walk out of the operating room with a clipboard and a chart," says Dr. L. S. Montejo. "Now I walk out with a floppy disk."

Dr. Montejo is a prominent anesthesiologist who is pioneering the use of personal computers in heart surgery. His unique idea for making quicker, more informed decisions led to a unique solution from TI: a portable PC he could talk to. Configured to his exact needs from the wide range of TI options.

"Using TI's Speech Command," he says, "I can respond to drug reactions faster, with the PC making calculations as I speak to it. And my hands are free to do other things.

"The information just flies by. But the computer organizes it, and by calling up color charts, I can make better decisions at a glance. It lets me provide better medical care."

In his office, Dr. Montejo uses a desktop TI Professional Computer to keep the business side of his practice operating smoothly. "Having to wait on a computer is a waste of valuable time," he says. "TI runs software fast. And the TI screen has a lot better resolution than other monitors."

His TI 855 printer also speeds up the paperwork. "We can use it to go from draft to letter quality immediately, and change typefaces very quickly by using the control panel instead of software commands."

TI had what the doctor ordered to put together a complete PC system for his specific needs. Including a solution for a budding computer genius in his family. "My daughter," he says, "loves her Speak & Spell."

TI has the right answers for the way you work.

With TI's broad line of versatile computer products, you can put together a system unique enough to put your own name on it. Your TI dealer can provide you with just the right combination of hardware, software, service and support for your special needs. For more information and the location of your nearest TI dealer, call 1-800-527-3500.

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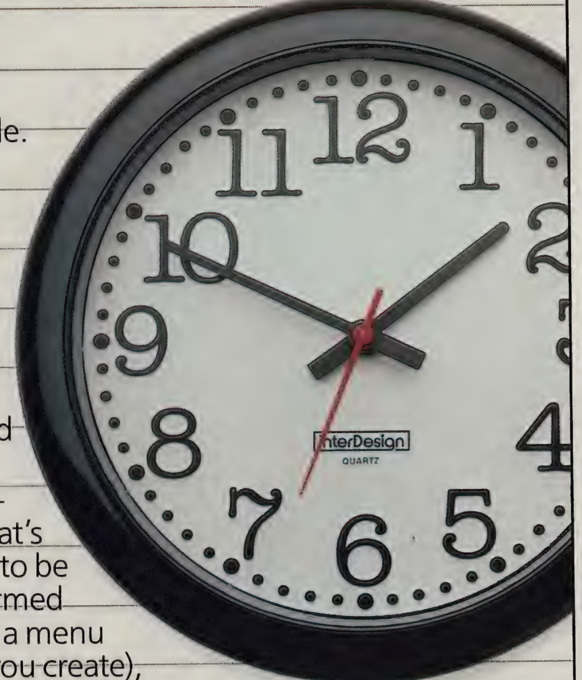
Front Desk: The better way to manage your most precious natural resource.

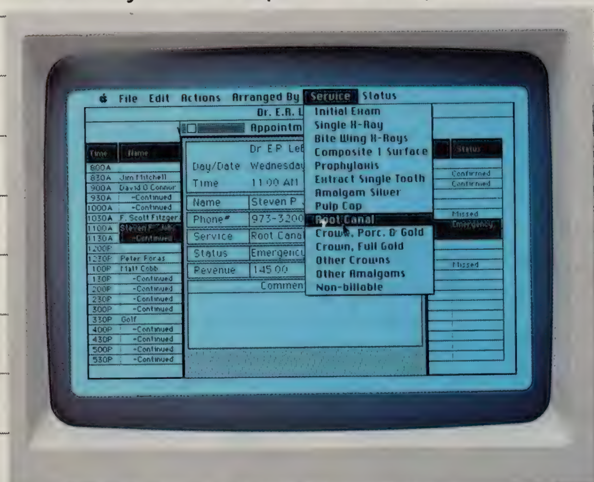
Front Desk™ is a time and resource manager for Macintosh™ that understands a simple fact.

Time is money.

It'll help you coordinate the time use of lots of people. Or schedule facilities. Or loan out equipment. Or plan projects. Or track a sales staff's sales. Or whatever. For a major company. Or a one-man-show.

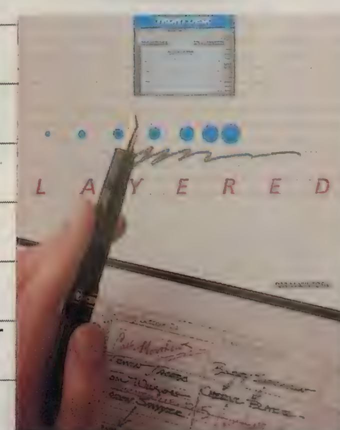


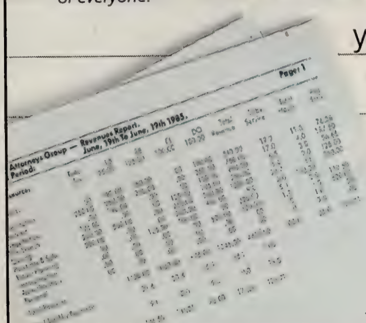
At first glance, it looks like a snazzy electronic appointment book. But Front Desk is no mere calendar. Not only does it organize *how* time is spent, it analyzes how *well* time is spent.



Front Desk lets you zoom from one person's calendar to the next. Or zip from a monthly view to a weekly view to a single day view. For one person or everyone.

When you click open the simple appointment entry form and select the service that's going to be performed (from a menu that you create), Front Desk automatically calculates the proper fee or rate. Then at any time you can print out an analysis report for last month showing how many hours you or your staff spent—or how many dollars you brought in—by holding consultations, or selling wickets, or playing golf. And you can project how much you'll bring in on those services in the coming weeks or months.





Front Desk creates reports analyzing time use in terms of hours spent—and dollars generated—per person, per service.

This lets you see where your profits are coming from. Where your time is going. You can spot trends. Nip unprofitable ventures in the bud. And decide who gets bigger Christmas bonuses. In short, you'll get more done. In less time.

So dash down to your local computer store today for a look at Front Desk. And buy yourself some valuable time.

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BY STEPHEN BANKER

Dream Software

Valdocs 2, after a long delay, is a real sleeper

"Eureka!" cried the Technoklutz in an early morning call. "It's come, it's *here*!"

"You got something?" I mumbled.

"Valdocs 2, that's all," he said. "I've been waiting for it forever for my QX-10."

"Forever?" I echoed.

"Haven't you heard from Epson users," he countered, "how many times it's been promised?"

"I do remember," I said, "the transcendental claims of the software honcho, Swami Chris, and that any-day-now prerelease demo a year ago. Unless I'm mistaken, Valdocs stands for 'Valium Dockside' because the early programmers liked to relax by a lake. But tell me, when did you get it?"

"At two a.m.," he said. "I was just musing about it when I thought I heard the doorbell. I got out of bed and opened the door and sure enough, there was the UPS guy."

"Get to the bottom line," I interrupted. "What's the software like?"

"A dream," said the Technoklutz.

"Ah," I responded. "How so?"

"First of all, there are no disks. *It's a silver bullet.* It's bundled with a pearl-handled delivery module. You shoot it at the screen and *pow!*—it's booted up. There's no welcome message."

"That's incredible," I breathed.

"And it's so fast," the Technoklutz went on, "that anything you do—saving, retrieving, zipping the cursor to and fro, tossing blocks around—is instantaneous!"

"And your old software had barnacles," I said.

"One of the neater features," sang the Technoklutz, "is that it completes your thoughts for you. For instance, I typed, 'Hello, how—' and it kept going, writing, '—are you today?' Well, when that happened, I gave it a *real* test. I typed, 'My favorite color is—' The screen glowed for an instant and then wrote, 'You don't have a favorite color.' "

"Just what I'd expect from a monochrome board," I commented.

"At times the program is almost too pushy. Like when I pressed the CALC button, it wrote, 'Sorry, you are not the sort of person who should use a spreadsheet.' "

"That's outrageous," I exploded.

"I would have agreed then," said the Technoklutz pensively. "But I got to thinking that if Val 2 is going to thumb its nose when *I* go for the CALC button, it's also going to cut the legs off those math nerds when they try to use the word processor. The trade-off is all right with me."

"A statesmanlike position," I conceded. "What else does it have?"

"Well, when I pushed SCHED, the screen said, 'Replace data disk with address book.' So I smushed my little black book into the B drive. The red light came on and the drive whirred as the data flowed into RAM. Then I entered the first three letters of your name, old scout, and there you were, work and home numbers, notes on our last contact, along with a line drawing of your distinguished features."

"Fantastic," I marveled. "What else?"

"Just a flyer about a board to convert the system into a microwave oven, using the disk drives for hamburgers, cookies, or french toast."

"Make sure there's a porcelain template before you order that one," I advised. "How about the manual?"

"None," sniffed the Technoklutz. "Swami says written documentation is an admission of failure."

"He can't afford to lose interface," I said. "And what's next for your dream software?"

"The first thing I've got to do is find it," said the Technoklutz. "I played with the damn thing all night, but this morning I can't seem to lay my hands on it. I sure hope it turns up soon. Because for someone who has used it at last, a day without Valdocs 2 is a nightmare." □

Contributing editor Stephen Banker's "Technoklutz" commentaries can be seen on the Public Television series *The New Tech Times*.

ILLUSTRATION BY JAMES ENDICOTT

THE WRITE

Alphacom
THE WRITE IMPRESSION.
An open letter on making a better impact with your printer
There is nothing like a daisy wheel printer for making a crisp, solid impression. Print your important business correspondence on the Alphacom Alphapro 101 and you'll make a superior impact, with printing quality that you can actually feel.
The Alphapro 101 strikes the page with fully formed characters, powerful boldfacing, true descenders, clean underlining and more, so you can get the most from your word processing--and other-- software.
You can't get this authentic letter quality from a dot matrix printer. You can afford the striking impact delivered by the Alphapro 101 daisy. The difference is in the impression you'll make. Isn't your image worth it?
Alphacom Alphapro 101

IMPRESSION.

Impact of a daisy. Price of a dot matrix.

A daisy printer prints with *impact.*

It makes an impression on the page with each and every character.

An impression you can see, and feel.

An impression no dot matrix printer or laser printer or inkjet printer can make.

Now there is a professional quality daisy wheel printer with a retail list price of only $399.

And at twenty characters per second, it has the kind of performance you demand.

Now you can afford a printer just for making good impressions.

The Alphapro 101 will make millions of good impressions.

In fact, it is delivered with a *full one-year warranty!*

The Alphapro 101 doesn't cut corners.

It's simply designed smarter. With far fewer moving parts. With fewer things to go wrong, you save over the years. That's why it's the only low-priced, high-performance, daisy printer that offers a full, one-year warranty.

Built to give you the most out of the leading word processing software and personal computers.

Not just compatibility.

But full advantage of the superscripts, subscripts, underlining, boldface, and other highlighting techniques you get with packages like Wordstar,® Microsoft® Word, or PFS®: Write.

And Alphacom's intelligent printer cartridge system tailors the Alphapro 101 to run with *all* popular personal computers. Apple® IIc™ and IIe.™ IBM® PC, XT, AT,™ jr. IBM compatibles. Radio Shack.® AT&T. You name it.

Compare price and performance. Then buy. Don't let your image wait another day.

See your Alphacom dealer for a demonstration. Satisfy yourself that this is, indeed, the finest value in a personal printer.

Then put the Alphapro 101 to work on your image right away.

For your local dealer, call (408) 559-8000.

Alphacom

THE WRITE IMPRESSION.

Inquiry 3

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Inside the INNER CIRCLE

An excerpt from a new book that examines who hacks and why, as told by the most notorious member of an elite group of hackers

BY "THE CRACKER"

There's been a lot of publicity lately about computer trespassers who illegally tap into large computer systems. Movies, television, and news articles characterize these hackers as everything from technological delinquents to playful whiz kids who can start the countdown of World War III—even before they have learned to swim. Where's the truth? Probably somewhere in between. So perhaps the best way to introduce you to hackers and hacking is by presenting my credentials.

My name is Bill Landreth. I am 19 years old, and I live in Southern California. About a dozen members of the FBI and many members of the hacking community, however, know me better as The Cracker, one of the leaders of an "invitation-only" group of hackers called the Inner Circle. I began hacking when I was 14, but my career came to a rather abrupt end in 1983, when I was caught and indicted for wire fraud—unauthorized access and use of the private, nationwide GTE Telemail computer network based in Vienna, Virginia. Since then, I have been convicted of the charge and placed on three years' probation.

If you are wondering what I am like, I can tell you the same things I told the judge in federal court: although it may not seem like it, I am pretty much a normal American teenager. I don't drink, smoke, or take drugs. I don't steal, assault people, or vandalize property. The only way in which I really differ from most people is in my fascination with the ways and means of learning about computers that don't belong to me.

THE MAGIC DOOR

It all started when a friend loaned me a terminal with a modem, and in the process of finding out what to do with it, I discovered the world of minis and mainframes. At first, I used the terminal to call up the numbers of some computer bulletin-board systems I knew of. When I was a newcomer to telecommunications, however, there were only a few public, non-hacker bulletin boards to choose from—one was local, and there were another five to seven within my area code. (I found out about them through various hobbyist magazines.) But no one ever seemed to use these public systems.

Then a friend told me of the phone number to a large corporate computer. He had no use for the number, so he gave it to me, and I called it. By all rights, that first attempt should have been my last. Sure, I had called the number and the computer had answered, but then what? A large, multiuser computer doesn't sit there and chat just because you feel like calling. It has to keep track of who's doing what, and when, and it does so by crediting every task, no matter how large or how small, to someone's account—an account that can be used only by giving the computer an account-name/secret-password combination it recognizes as valid. No account, no access; as far as the computer is concerned, you don't exist.

"The Cracker" is the on-line alias of Bill Landreth, the teenage author of *Out of the Inner Circle* (Microsoft Press, 1985).

ILLUSTRATION BY ROBERT ANDREW PARKER

After calling and seeing the computer's prompt for an account name, I started to try first names. For some unknown reason, I stuck to three-character names and tried the same ones as both the account name and the password. First, I tried DAN. No luck. Next, I tried JIM. Nope, too bad. My third try was LEE. Against odds no gambler would ever bet on, it worked. My luck was incredible: three tries, with no clues, and I hit on a valid account/password combination.

It's hard to describe the excitement I felt when LEE unlocked the magic door to that corporate computer. I was expecting to see "Access denied" for the third time, and instead the screen cleared and the name of the company that owned the account appeared on the screen. I guess a winner of the Irish Sweepstakes must feel the same way I did then; I really thought I had no chance of getting into that computer. To my surprise and delight, my first attempt at hacking was a success! I opened the door to a whole new kind of computer to learn about. By the time I was discovered by the system operator about three months later, I had learned enough about the computer's operating system to have discovered about 30 accounts. And it was here that I learned just how complex a computer can be.

BECOMING THE CRACKER

While I was exploring that first computer, I was also using the terminal to look around for interesting microcomputer bulletin-board systems. Eventually, I ran across a few bulletin boards that were used by software pirates—people who trade illegally copied computer software with one another. On these boards, I ran across a bit of information on "hacking" every now and then.

I wanted to get more involved with larger computer systems, so I established computer contact through these bulletin boards with the few people who called themselves hackers. Through these contacts, I soon found that there were many more of these bulletin-board systems around the country. Each one offered more information for me to try out—new phone numbers, account names, passwords, special tips, and so on.

As I used and tested all this new information, I expanded my knowledge of different operating systems running on different mainframe computers. Soon I learned what types of commands are likely to exist on any operating system, and I learned how to find them. I became familiar with the ins and outs of the most common operating systems, and I found out about some of the security weaknesses of the most common systems. I also learned, from trial and error as much as anything else, how to go about trying to acquire more powerful accounts on a particular system. An account with a programmer's privileges, for example, would allow me to control the system more than, say, a data-entry clerk's account. Once I started putting this knowledge to work, I could start trading information with other hackers.

Information is the currency of the hacker's bulletin-board culture, and trading is the means of exchange. Accounts take a lot of work to get, so most hackers are unlikely to post information publicly when they can trade it for more information from other hackers. In addition, an average hacker acquires only four to five new accounts in a year, and all but maybe one of these accounts die within six or seven months. That same hacker could, however, trade those four or five accounts four or five times each, and those exchanges would net him as many as 25 different accounts for the year.

A more important reason for trading, though, is to keep information out of the hands of novices. Often, when novices get hold of publicly posted information, they abuse it by sending obscenities to the system operator, destroying information, changing passwords, or removing accounts. Moral arguments aside, hackers dislike this kind of abuse because accounts that are abused are discovered and die quickly.

Like many newcomers who later turned to me for advice, I sought information from those who were more experienced than I was. First I learned that I was not expected to leave my real name anywhere. In fact, it was considered stupid to do so. Everyone involved with hacking chose a handle that was used as a name on all the hacker bulletin boards. I chose to become The Cracker and set out to establish a reputation among other hackers.

I posted messages on hacker bulletin boards, advertising that I was willing to trade any information I had. I realized that I could be accepted as a bona fide hacker relatively quickly by trading only the highest-quality information. Within a few months of my first postings, the word began to get around: The Cracker is OK.

And after several months of intensive hacking and information-trading, I was no longer a novice. And because I liked to share what I knew, I gained the reputation of being someone to go to if you were having trouble. After a while, people would leave messages saying, "I know you can't help me, but I would like to get onto this system . . .," and to their surprise, I could usually help them out. As The Cracker's reputa-

My luck was incredible. Against odds no gambler would ever bet on, I hit on a valid name and password on my third try.

This article has been adapted from *Out of the Inner Circle: A Hacker's Guide to Computer Security*, Microsoft Press. Copyright © Bill Landreth, 1985. All rights reserved. In addition to examining the hacker mentality, the book specifies strategies for recognizing hackers' methods and techniques, identifying traces they leave behind, and securing computer systems against these would-be intruders.

tion grew, answering such requests became a matter of pride. No matter now difficult the question, I would sit at the terminal for 5, 10, 20 hours, until I had the answer.

FORMING THE INNER CIRCLE

When I first started hacking in 1980, hacker bulletin-board systems were few and far between. But the number of people who began to explore telecommunications and large computers increased dramatically in 1981 and 1982. New hackers popped into the networks every day.

During this time, it became very difficult to tell who you could safely

trade information with. Sometimes, the person you gave the information to would abuse the account himself, thus rendering it useless to you. Other times, the person would post the information publicly and claim credit for getting the account.

It was during this time that the Inner Circle was formed, and the person most responsible for its formation was the person who taught me the most about hacking. His handle was Alpha Hacker. I "met" him through one of the bulletin boards, and it was clear from our first communications that he was a hacker among hackers. We have never met face to face, and I still don't know his real name.

Alpha Hacker was interested in forming a kind of high-level hackers' guild because of his concern over who might get their hands on the most useful and sensitive pieces of information we turned up. The concept of the Inner Circle was that the best hackers would meet on private bulletin boards and post their information for other members to see. We would create password security systems on these special bulletin boards —security systems strong enough to resist the efforts of other hackers. With these systems in place, we would not have to worry about trading information; all we had to do was place information in the message base and check back to see what was there every now and then.

The Inner Circle was formed in early 1982. Alpha Hacker and I picked the best hackers that we knew. And to make sure we kept strict control over membership and over how information was to be used, we decided to form a kind of tribunal that we called the Inner Circle Seven.

Our organization and membership policy actually turned out to be a very timely idea (from our point of view, anyway) because not long after we formed the Inner Circle the movie *WarGames* was released, and in its wake came a flood of eager-beaver new hackers. In a matter of months the number of self-proclaimed hackers tripled, then quadrupled. You couldn't get through to any of the old bulletin boards any more—the telephone numbers were busy all night long. Even worse, you could delicately work to gain entrance to a system, only to find dozens of novices blithely tromping around the files.

MEMBERSHIP REQUIREMENTS

When Alpha Hacker and I were deciding whom to invite into the Inner Circle and whom not to include, we kept two different requirements in mind. First, each member had to have proven he could get good information on his own. Second, we agreed that every hacker in the group must be the kind of person who could be trusted not to abuse account information given to him by other hackers.

These two requirements quickly resulted in an unwritten code of ethics that became the philosophy holding the Inner Circle together. This code had two practical uses for our group. The most apparent was that information we gathered would remain useful for a longer period of time. But just as important, our approach served to keep the system operators on our side. If the code had ever been written, it would have looked something like this:

No Inner Circle member will ever delete or damage information that belongs to a legitimate user of the system in any way that the member cannot easily correct himself.

No member will leave another hacker's name or phone number on any computer system. He will leave his own name only at his own risk.

All members are expected to obtain and contribute their own account information, rather than using only information given to them by other members.

We had many good reasons to follow these basic rules. But the most important, as far as the Inner Circle was concerned, had to do with the basic principle of respecting other people's property and information. We spent long hours tapping into as many large computer systems as we could find, including systems belonging to banks, newspapers, schools, the phone company, and credit bureaus. But we were explorers, not spies, and to us, damaging computer files was not only clumsy and inelegant—it was wrong.

UNDERSTANDING HACKERS

What makes hackers hack? Why are they so dedicated? Why do they spend so much of their own time on other people's computer systems? And just what do they think they are trying to accomplish? It's not rare for a hacker to put in a 60- or 70-hour work week (without getting paid, of course). And these are not empty hours, filled by staring out the window. Hacking is a challenge and a game of wits, and during their work sessions, hackers use all the skills and ingenuity they have developed. Hackers enjoy what they do.

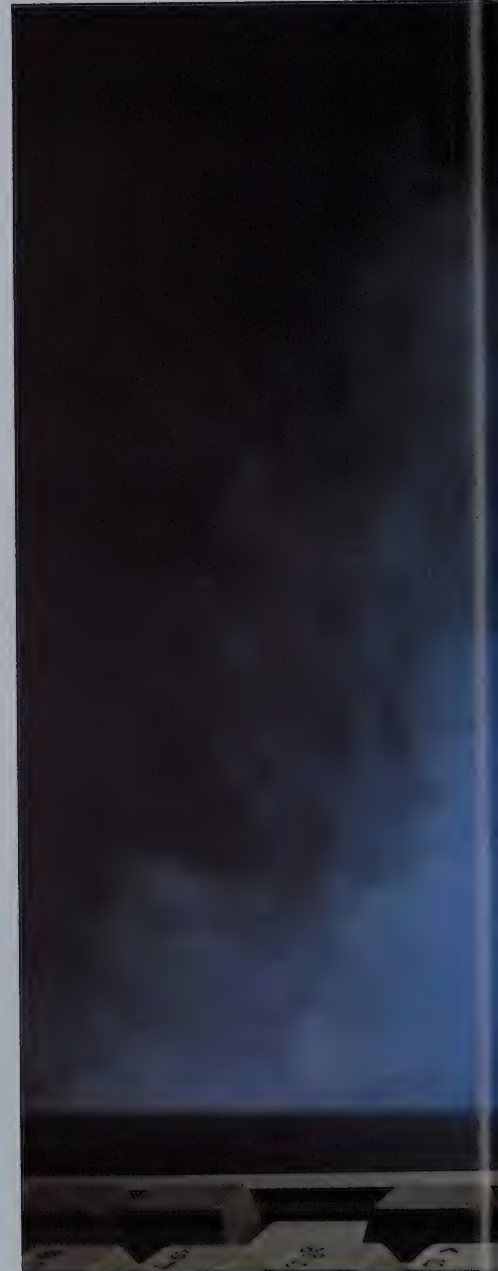
From my years as a hacker, and from my years of communicating with other hackers, I can safely say that the majority of hackers follow all the —*Continued on page 146*

SPECIAL REPORT: PART ONE

ARTIFICIAL INTELLIGENCE

The goal looms larger than life but researchers can't agree on how to build an intelligent machine

BY TOM ALEXANDER



MOSQUITOES ARE NOT GENERALLY THOUGHT OF AS intelligent beings. Yet even today's largest and fastest computers can't match the raw processing power of a mosquito, with its ability to fly, navigate, and land; to identify targets, mates, and breeding areas; to survive as a species over millions of generations in a changing, unpredictable world. And the mosquito possesses only a few tens of thousands of neuron brain cells; a human being possesses closer to a trillion.

Scientists who are trying to make machines think like humans are facing what may very well be the toughest goal mankind has ever set for itself. Furthermore virtually every researcher in artificial intelligence (AI) seems to have his favorite ideas about the best route to take to that goal. Some are convinced that intelligent computers must have mobility and be able to deal with sensory information; others argue that logic is of prime importance, while still others say that rather than powers of logic, a computer must comprehend meaning before it can exhibit intelligent behavior.

Hans Moravec, a research scientist at Carnegie-Mellon University's Robotics Institute in Pittsburgh, is one of those who believe that the route toward AI is learning to build mobile robots, machines that can get around on their own in the real world. More optimistic than most of his colleagues, Moravec predicts that in 20 years robots with human-level intelligence will be walking the earth.

Now in his mid-30s, Moravec has spent about four-fifths of his lifetime constructing robots. He built his first at age 7, and his first "serious" robot, of tin cans, a motor, batteries,

and wire, at age 10. He has been building robots ever since, at Stanford, and now at Carnegie-Mellon. Among his accomplishments is the Stanford Rover, the first vision-equipped robot that could recognize obstacles and replan its course to avoid them.

Mobility, in Moravec's mind, is of utmost importance. This critical factor, he says, forces adaptability and generality and it doesn't forgive cheating in the form of declaring some computer to be "intelligent" when it can actually perform only one fixed, programmed task. Mobility puts a premium on general talents such as sensory perception, pattern recognition, and learning—talents that humans have in common with lower animals but that turn out to be harder to automate than things that are hard for people, such as playing chess or diagnosing diseases.

Still, Moravec believes that AI researchers are needlessly demoralized by the discovery that what comes natural to people resists being translated into computer code. He used to have long arguments about that with his Stanford thesis adviser, John McCarthy, one of the founders and leading theorists of the AI movement. "There was a very strong perception among the pioneers that they almost had it," says Moravec. "They believed that if the hardest things, like chess and checkers and solving geometry problems, are so easy to do on machines, surely the low-level things would be easier still. Now McCarthy thinks it

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PHOTOGRAPH BY MIKE BLAKE

will take an Einstein or a Newton to achieve machine intelligence. I don't think that's right. I think it's mainly a matter of faster computers."

Moravec believes those faster computers are on the way. "In the early 1990s," he predicts, "we'll have relatively cheap little computers that can perform about a billion operations per second instead of the million they perform now. By my calculations, a billion operations per second is about equivalent to hummingbird intelligence. A decade after that we'll have machines that can perform a trillion operations a second, and that's about what's required for human-level performance."

"What does that mean?" inquires a visitor.

"Anything humans can do, a machine will be able to do."

"You mean it could stand in the outfield and see the ball leave the bat and run out and catch a fly?"

"Yes."

"You mean it will be able to leave this room, go downstairs, call a taxi, go to the airport, get on a plane, fly to Washington, read some research, and start writing about artificial intelligence?"

"Yes," Moravec says, then pauses and hedges a bit, perhaps to console his visitor. Maybe, he concedes, certain professional abilities might take a little longer to reproduce.

Nowadays most AI researchers would regard Moravec's optimism as excessive. Marvin Minsky of the Massachusetts Institute of Technology, one of the four or five principal founders of the AI movement, thinks we'll be lucky to see even a capable household robot inside a hundred years. And John McCarthy thinks genuine machine intelligence will take much more than a faster computer; it will, he says, take "1.7 Einsteins."

It's reasonably clear how to solve parts of the problem of building Moravec's writer-robot, like, say, planning the trip from Pittsburgh to Washington. It could be equipped with tables of distances between relative points, such as cities to cities, cities to airports, homes and offices to taxi stands and railroad stations. And it could have lots of knowledge about the best modes of transportation for given distances: that airplanes are preferred for distances greater than, say, 200 miles; trains (if they exist) for distances between 75 and 200 miles; cars between 5 and 75 miles; taxis between one and 5 miles; and walking for less than a mile. Given enough of that kind of knowledge, a computer could probably sketch out a travel plan adequate to the average person's needs.

But to physically make the trip itself, it would need sensory and motor abilities to walk, handle, see, read, hear, talk, and above all comprehend and deal with expectably unexpected circumstances that still lie somewhere out beyond the hazy frontiers of invention.

DEBATE over the role logic plays in getting machines to think forms one of the major controversies polarizing theorists hard at work in AI's ivory towers.

Finally, to carry out the rest of the mission, distilling and writing about its researches, the robot would also have to possess at least some knowledge of possibly millions of unobviously "obvious" things, things like computers and robots and space and travel and the 1960s and intelligence and magazine editors and what readers knew or might care to know. In short, something, however little, about the indivisible, continuous fabric of almost everything.

Like all digital computer programming, the entire AI edifice is built upon various principles of symbolic processing. The first digital computers, or "automatic calculators," as they were sometimes called, employed mathematical logic to manipulate numerical symbols and solve equations. But it didn't escape the notice of their brilliant inventors that the same machines could just as easily manipulate nonnumerical symbols—letters, words, chess positions, even maps and diagrams—anything that can somehow be encoded as sequences of the binary digits 1 and 0.

This opened prospects for mechanizing nonnumerical, deductive logic, revered by the ancients as the highest form of human thought. Just as algebra amounts to a collection of rules for legally substituting terms in equations, logic consists of rules, called axioms, for substituting one statement for another, permitting inferences, or theorems, to be drawn. Given the statements "Socrates is a man" and "all men are mortal," for example, a simple axiom allows one to infer that Socrates is mortal. Such rules can be expressed in various ways; in a computer program, they often take the equivalent of the IF-THEN or the IF-AND-THEN form; for example: "if object A is a member of a class of objects B, and if all members of B have the property C, then A has the property C."

Such logical operations rely on the computer's ability to search and match symbols. If the machine can find some kind of match between the pattern of symbols on the IF side of a rule, that may trigger its replacement by the THEN side. Logic also relies on the machine's ability to create connections in its memory. A major virtue of the LISP programming language, the favorite of most AI programmers, is its facility for creating such memory structures. (For a review of Golden Common LISP, see page 116.) Another favorite AI language, Prolog, is especially good at facilitating logical inferences.

In AI's beginnings, the late '50s, researchers were so enthralled by the power of the computer to search for patterns of symbols and apply axioms as to imagine that the apparent complexity of intelligent behavior could readily be reduced to some fairly general but spartan logic. That assumption encouraged them to believe that machine intel-

ligence was just around the corner.

As recently as 1965, one of the pioneers, Herbert Simon, was asserting that "machines will be capable, within 20 years, of doing any work that a man can do." Together with colleagues John Shaw and Allen Newell, Simon wrote a program, called Logic Theorist, that could prove many of the theorems of formal logic. It is generally credited with being the first program in the AI tradition.

Logic Theorist and many of its successors relied heavily on simple and general rules of logic, trying many possible combinations of symbolic statements to arrive at a desired proof. However, as researchers left the artificial and austere world of formal logic for more realistic domains, such spartan approaches become impractical.

A marginally less artificial domain, for example, is playing chess. The naive approach to computerized chess would be to equip the computer with the rules of play—comparable to the rules of logic—and instruct it to search through every possible move and every possible response until it simply discovered the sequences required to play the perfect chess game. The trouble with this brute-force method is that each move opens up rapidly branching possibilities for so many responses and counter-responses until even the fastest computer would take billions of times longer than the age of the universe to evaluate all possibilities.

Human players, of course, get around this problem by supplementing the formal rules of chess with informal rules of thumb (technically known as "heuristics") or expert knowledge, to narrow and guide their search.

Over time, in fact, AI has come to depend less and less on the simple, general-purpose logic and reasoning from first principles that the pioneers had hoped would suffice. The heuristics or IF-THEN rules have grown increasingly fine grained, specialized, and numerous, until now, the virtual synonym for applied artificial intelligence is "knowledge-based programming." It consists primarily of systems incorporating large collections of knowledge in rule form, together with special techniques for applying the proper rules at the proper time. This approach is epitomized by expert systems, scores of which are now being used or developed in both industry and academia (see "Expert Systems," page 70). Even so, many academic researchers in artificial intelligence, including Moravec, Minsky, and McCarthy, deny that expert systems really qualify as intelligent in any legitimate sense of the word.

The paradox is that as expert systems become more successful, they tend to become less intelligent; that is, narrower, less resilient, and less able to cope with unexpected situations. By way of illustration, it would be a trivial feat to write a robot program to solve a particular maze by specifying which way to turn at every juncture. But no one would regard such a robot as being as intelligent as, say, a rat that solves the maze, however slowly, by trial and error. Unlike the program, the rat could learn a new solution if the maze were changed.

It's the ability to cope with change and to incorporate new information to improve performance that defines intelligence. So AI theorists like Minsky are distressed that many of the best people in the field are being diverted from that besetting challenge by the lucrative prospects in "unintelligent" projects like expert systems.

The Continental Divide

Not all AI researchers have been so diverted, to be sure, but those who haven't are sharply divided on how to proceed. One continental divide that has elevated itself in recent years concerns logic itself. Some theorists argue that no matter whether people actually think logically or not, logic of one form or another is still the only feasible route to reducing artificial intelligence to a teachable discipline, programmable on digital computers. These logic proponents tend to be concentrated on the West Coast, under the leadership of John McCarthy of Stanford and Nils J. Nilsson, who heads an extensive AI effort at the Menlo Park consulting firm SRI International.

In the East, by contrast, theorists like Marvin Minsky at MIT and Roger Schank of Yale contend that the correct strategy consists of discovering and modeling how people think. Furthermore, according to this view, however people think, it doesn't have much to do with logic. One trouble with ordinary logic is that it's much like mathematics, being all form and no content. When it inferred logically that Socrates is mortal, the machine had no inkling of meaning, of the rich associations that terms like "Socrates," "men," and "mortality," arouse in people who hear them. The Eastern school believes that machines will have to grasp meaning before they can display intelligence.

To replace logic and simple IF-THEN rules, for example, Minsky devised the notion of "frames"—elaborate packages of stored knowledge that, like memory associations, are evoked by pattern matches. A frame describing a given disease might contain separate "slots" for each symptom as well as for the likely causes, effects, and treatments of that disease. Given certain symptoms as keywords, the machine could page through its collection of frames to find the most likely cause, implications, and cure.

The controversy over logic takes starkest form in the question of how to get computers to understand "natural" human languages such as everyday English. The prevailing West Coast approach is to analyze syntax, applying IF-THEN rules to reduce sentences to their component parts—nouns, verbs, and so forth. Once that is done, a computer can interpret a command like "Who are our midwestern salesmen," by searching a data bank for categories labeled "salesmen" and "midwestern" and performing the proper sorting operations.

The Eastern camp, by contrast, believes that for all but the simplest communications and applications, syntax is virtually useless. Instead, they base their hopes on semantics or meaning. In their view, computers will need something very much like associations and mental images to resolve the —*Continued on page 142*

SPECIAL REPORT: PART TWO

EXPERT SYSTEMS

Expert systems on mainframes have proved their utility, and now they're entering the micro world in force

BY JONATHAN AMSTERDAM

NOT LONG AGO, AN INTERNIST AT THE UNIVERSITY OF Pittsburgh was tested on some cases from the medical literature. Given the same information about the patients that the attending physicians had, such as symptoms and test results, the internist considered each case carefully and produced a diagnosis that, more often than not, agreed with that of the physicians.

Well, that's hardly surprising. The unusual aspect of this tale is that this internist was not a doctor, but a computer program developed by a physician and a computer scientist at the University of Pittsburgh.

Internist-1 is an expert system—a program that can do some of what human experts can do. Once solely a topic for researchers in artificial intelligence (AI), expert systems are performing real tasks in the real world. You'll find them in offices, hospitals, research labs, repair shops, and at oil wells, among other places.

Not only are several major companies like Digital Equipment Corp. and General Electric building them for internal use, but for those firms that don't wish to invest in in-house development, new companies with names like Syntelligence, Teknowledge Inc., and Intellicorp are popping up in Silicon Valley and elsewhere, heavily backed by venture capital and devoted to marketing either complete expert systems or the software tools for building them.

All this activity in expert system development is causing great excitement. After more than two decades in the making, expert systems are finally achieving levels of performance comparable with those of human experts, making them very attractive commodities indeed. Expert

PHOTOGRAPH BY MIKE BLAKE

systems are expensive, but by performing the jobs of even more expensive human experts, they can pay for themselves very quickly. For example, Prospector was developed at the Stanford Research Institute to help find valuable mineral deposits. On one of its first runs, it uncovered a molybdenum deposit that experts had overlooked for years, possibly worth as much as $100 million.

And while expert systems have until now required large computers to run, a number of firms are developing micro programs that bring some of the power of expert systems down to the personal level.

A Historical Perspective

Expert systems are an outgrowth of a line of AI research begun in the mid- '60s. Edward Feigenbaum of Stanford University was interested in the problem of mechanizing the thought processes of scientists. At the same time, Joshua Lederberg, a biologist also at Stanford, wanted to write a computer program that could understand the mass spectographs of chemical compounds. Dendral, the program born of their collaboration, was the first expert system and is still used in many chemistry labs.

Feigenbaum next worked on automating medical diagnosis. The outcome of his collaboration with physician Edward Shortliffe was Mycin, a program that can diagnose a narrow class of diseases. Mycin is a landmark expert system in several ways. It was the first to employ the *rule-based inference* method now used by nearly all expert systems. Also, it was the first expert system that had the ability to explain the steps in its reasoning. And its performance—almost as good as that of physicians in its narrow domain of expertise—was the first real indication that this new technology might have practical applications.

Expert systems are more than just "smart" programs, such as those that predict the weather. Weather-prediction software does little more than compute changes in the pressure and temperature of air masses based on complex but well-defined physical formulas. It's simply a matter of massive number crunching.

Expert systems manipulate data, to be sure, but their focus is different. Several criteria distinguish an expert system from a merely smart program. The expert system's field of expertise—its domain—is inherently hard to quantify. That is, the domain can't be so well understood that writing a program for it would be easy. For a problem to be a good candidate for an expert system, it must be complex enough to require experts, solvable by no one procedure or algorithm, and constantly changing as new knowledge is acquired.

Medical diagnosis is a perfect candidate for an expert system. There's no equation for finding out what's wrong with a patient; instead, doctors rely on the accumulated experience of treating thousands of cases, abstracting general principles, and applying them to new cases.

A subtler difference between expert systems and smart programs is that some expert systems, or so researchers claim, mimic the way a human expert solves problems. Whether they do is a difficult and hotly debated question, but it certainly appears that expert systems capture a little of the complex process of human reasoning. Let's take a closer look at Mycin to see how expert systems operate.

Mycin's Inner Working

Mycin diagnoses infectious diseases and suggests possible therapies. The program works by interviewing the patient's attending physician. The physician begins by entering the basic facts about the case such as the patient's name, sex, and age, then Mycin follows up by asking specific questions about the kinds of infections the patient has and the organisms that have been isolated. At the end of the interview, Mycin produces a ranked list of possible diagnoses:

Infection-1 is primary-bacteremia
<ITEM 1> The identity of organism-1 may be pseudomonas-aeruginosa
<ITEM 2> The identity of organism-1 may be klebsiella-pneumoniae
<ITEM 3> The identity of organism-1 may be E. Coli
<ITEM 4> The identity of organism-1 may be bacteroides-fragilis
<ITEM 5> The identity of organism-1 may be enterobacter
<ITEM 6> The identity of organism-1 may be proteus-non-mirabilis

How does Mycin get from the facts to the diagnosis? To begin with, it has a *knowledge base* of about 500 rules that describe what experts know about diagnoses. The rules are all in the form "IF some condition or conditions are true, THEN some conclusion follows." For example, Mycin's Rule 050 is: IF (1) the infection is primary-bacteremia, and (2) the site of the culture is one of the sterile sites, and (3) the suspected portal of entry of the organism is the gastrointestinal tract THEN there is suggestive evidence (.7) that the identity of the organism is bacteroides.

Mycin's rules aren't dogmatic about their conclusions: each rule has a value between 0 and 1 attached to its conclusion to indicate its certainty.

Just the rules aren't enough, though; Mycin has to be able to use them in a meaningful way. And this is the job of the *inference engine.* An integral part of Mycin and all expert systems, the inference engine is a program separate from the knowledge base that uses the rules together with the data provided by the physician to reason about the possible causes of the disease.

Designers of early expert systems reasoned that one way to get expert systems "thinking" would be to take all the facts fed into the program and see which IF parts of the rules they matched. Once all the clauses of an IF were satisfied, the THEN part—the rule's conclusion—would be activated. The conclusion could be used just like another fact in the search for more rules whose IF parts were satisfied. When the program got stuck, it could ask questions.

Precursors of Mycin reasoned in this "bottom-up" fashion, from the low-level facts about the case up to the final conclusion. But Mycin

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operates differently because its builders noticed that human experts didn't appear to work this way. For instance, a bottom-up system asked questions in a strange order. It would seem to be tracking down one idea or hypothesis, then suddenly switch to another. This happened because the program simply looked for any IF clause to satisfy and didn't try to pursue any particular "train of thought." That is, instead of forming a hypothesis and then trying to verify it, the program tried to discover new facts, in any order, until it had enough to succeed. It's as if a doctor performed tests at random on a patient until he or she gathered enough information to make a diagnosis, instead of making an educated guess and then trying to verify it.

Mimicking Humans

So Mycin's designers made it work "backward." The program begins with a hypothesis and then tries to prove it by looking at the THEN parts of the rules and seeing which of them satisfies the first part. It takes the IF parts of those rules and tries to prove them in the same way—by looking for THEN parts that establish them. Eventually it reaches statements that it knows to be true because they were facts entered by the physician; or it may get stumped and have to ask for more information. For example, say Mycin's current hypothesis is that the disease-causing organism is bacteroides. The program notices that rule 050, as stated above, relates to this hypothesis.

Mycin then treats each of the three IF clauses of the rule as a new hypothesis and tries to demonstrate it in the same way: by asking questions, searching its store of known facts, or using rules.

The "top-down" or "backward-chaining" Mycin behaved much more naturally than "bottom-up" or "forward-chaining" programs. Its questions followed understandable patterns; it seemed to act more like a human in that it proposed a solution and then looked for supporting evidence. Mycin's backward-chaining type of inference engine operating on a large database of rules became the standard structure of most subsequent expert systems.

But Mycin could do more than just blindly deduce: in conjunction with another program, Teiresias, it had a limited ability to explain its reasoning process. Instead of answering any question, the physician being interviewed could elicit Mycin's reasons for asking the question merely by typing "why".

In response to Mycin's question *What is the suspected portal of entry of organism-1 into this sterile site?* the physician could type **WHY [i.e. why is it important to determine the suspected portal of entry of organism-1 into this sterile site?]

Mycin would reply *In order to find out about an organism or class of organisms for which therapy should cover.*

It has already been established that the site of the culture is blood, and the stain of the organism is gram positive. Therefore IF the portal of entry of the organism is G.I. [abdomen is the locus of infection, or pelvis is the locus of infection] THEN there is strongly suggestive evidence (.9) that enterobacteriaceae is the class of organisms for which therapy should cover.

[Rule 095]

Teiresias is able to explain Mycin's reasoning because it keeps track of Mycin's hypotheses as they're generated. In this case, Teiresias knew that when the doctor asked why, Mycin's current hypothesis was that Enterobacteriaceae was the class of organisms responsible for the disease and that it had already established two of the four subhypotheses that would confirm its guess.

Mycin's self-explanation feature was one of its strongest points because it made its users more comfortable. Physicians didn't have to take Mycin's word for anything—they could always ask it what it was up to. In fact, Teiresias lets doctors change Mycin's rules if they think the rules are incorrect. Expert systems are designed to give the person control over the program, and not, as so often happens with computer programs today, the other way around.

It wasn't long before Mycin and programs of its ilk were attracting some attention from outside AI's ivory towers. In 1978, Digital Equipment Corp. (DEC) approached John McDermott of Carnegie-Mellon University with a suggestion: build an expert system to configure DEC computers.

DEC allows its buyers a great deal of freedom in choosing the parts of their computer systems, and until recently only a handful of experts knew enough about the way the separate components interacted to assure customers that they were buying a working configuration and make the necessary adjustments if they weren't.

A Success Story in Industry

DEC's system configuration problems and the corresponding headaches were big enough to make the company think seriously about automating the process. But the usual software engineering methods failed, so DEC consulted the expert system experts. Three years after McDermott took the job, DEC was using his creation, XCON, to configure systems. Now XCON is the largest expert system in daily use in industry anywhere in the world. And DEC's few configuration experts give the boring, routine jobs to the program and spend their time on the configuration problems that are beyond XCON's scope.

Encouraged by XCON's success, DEC is already using a second system, XSEL, designed to help its salespeople choose the right computer configurations for customers.

General Electric is also making profitable use of expert system technology. Before the development of its expert system, DELTA/CATS-1, GE had only two ways to fix its more seriously ailing locomotives. GE could either fly its sole locomotive maintenance expert, David Smith, out to the sick train, or somehow transport the locomotive to Smith. Both methods were expensive. But with DELTA/CATS-1, now in its final phase of development, GE's field service engineers will have some of Smith's expert knowledge—encoded in 1200 IF-THEN rules—at their fingertips.

Until recently, expert systems required fancy, expensive computers and fancy, expensive programmers to run them. —*Continued on page 150*

A Beginner's Guide to Assembly Language

BY TOM WESTHEIMER

Part 2: Tackling the details of Apple, IBM PC, and TRS-80 programs

LAST MONTH, IN THE first part of this two-part series, we introduced you to assembly-language programming and the computing power and time-saving features it opens up. With the aid of our imaginary primer computer, we illustrated how assembly language works and explained its basic concepts and terms.

This month we invite you to work through some actual programming. We present assembly-language programs for Apple IIs, IBM PCs, and TRS-80 Models I, III, and 4 that you can type in and run (see pages 74, 76, and 154). We also look more closely at the microprocessors in these computers, provide full explanations of the programs, and describe the tools you'll need to pursue assembly-language programming.

Tom Westheimer, who lives in Peterborough, New Hampshire, is a computer consultant and president of Copyright Corp., which sells a hardware-based software protection system.

A Trio of Microprocessors

As we saw last month, instructions in an assembly-language program depend largely on the particular microprocessor that your computer uses and its unique instruction set. Each of the computers we discuss here uses a different microprocessor. The Apple II uses a 6502, the IBM PC uses an 8088, and the three TRS-80s use a Z80 microprocessor. The assembly language for each has different instructions and mnemonics, different ways of using memory, and different registers where variables are stored and instructions are carried out.

The 6502 has 6 internal registers, the 8088 has 14, and the Z80 has 22. The registers of each microprocessor also hold different numbers of bits. The 6502 has only 8-bit registers, while the Z80 has 8-bit registers that can be combined into 16-bit registers for certain instructions. All registers in the 8088 are 16 bits wide and can handle data in lengths of either 8 or 16 bits, depending on the instruction.

Besides differences in the registers, each microprocessor also has its own language—unique mnemonics, grammar, and syntax. These variations mean that each has a different way of doing basically the same thing. The 6502 has 56 instructions, the 8088 has 135, and the Z80 has 158. All these instructions can be broken down into several categories:

- arithmetic—perform addition, subtraction, and sometimes multiplication and division
- data transfer—load and store data to and from memory and registers
- logical—carry out Boolean operations (that is, logical ANDs, ORs, and other operations)
- microprocessor control—handle pauses, halts, and interrupts (signals that instruct the microprocessor to stop its current task and perform another task)
- comparison and test—compare bytes and test to see if single or multiple bits meet specified conditions
- conditional transfer—branch or jump as a result of a previous test
- unconditional transfer—handle subroutines and interrupts

The ways in which these instructions access data are called addressing modes. These modes allow the microprocessors to retrieve and manipulate data efficiently. For example, in the programs presented here, we use indexed addressing, which lets us put the address of the beginning of a string into a register and then access each character in the string by incrementing the register value with a single opcode (instruction).

Other addressing modes use memory locations as pointers to subroutines that we need to call frequently. Some modes can increment or decrement the values of a register and move blocks of data automatically. The 6502 has 11 addressing modes, the 8088 has 25, and the Z80 has 9. Usually certain registers in each microprocessor are used for special addressing modes.

All these varying factors demand that you do some preparation and homework before you begin to write a program. Let's look now at these initial steps.

The Preliminaries

Each of the three programs presented here performs the same operation: it scans a string character by character and converts all alphabetic characters to either uppercase or lowercase. This type of function has many uses. When you search or sort data, for example, you often need to make sure that all the characters in a particular file or string are the same case. As you'll see when you type in the program for your computer, assembly language converts a string to a particular case about 50 times faster than BASIC can.

For all three programs, we first determine how BASIC stores string variables in memory so we can figure out how to access and alter a string with an assembly-language routine. In each case, the BASIC interpreter uses a string descriptor to keep track of strings.

The string descriptor contains three bytes of information. The first byte is the length of the string, which cannot be larger than 255 characters. The next two bytes are the address of the string in memory; specifically, they point to the location of the first character. The first byte in the address, reading from right to left, is called the least significant byte (LSB), and the second byte is called the most significant byte (MSB). For example, if a string is located at the hexadecimal address F856, we call 56 the LSB and F8 the MSB. Addresses are stored in this sequence because all three micropro-

For Apple IIs: Converting a String to Lowercase

This program runs with Applesoft BASIC and converts all characters in a specified string to lowercase. You can put the object code in memory by using the Apple Monitor, a utility program that lets you examine and alter memory.

To enter the Monitor program, at the Applesoft prompt] type CALL -151 and hit Return. You should then see the Monitor prompt *. Now type in the code that starts in line 8 of the listing—959C:20 E3 DF 85 06 84 07 and so on; separate each byte by a space and hit Return when you've finished. Type 959C.95C7 to check your work. Type 959CL to see a disassembled listing of the code, and type L to see the final few lines of the code.

To save the object code in a disk file, go back to Applesoft by typing 3D0G. Then type BSAVE UPCASE.OBJ, A38300, L44.

Line 1 is a comment header that identifies the routine. Line 2 sets STPTR equal to the address of a routine in BASIC that finds the string descriptor. (The assembler uses $ to indicate a hexadecimal number.) Lines 3, 4, and 5 are equates for HIMEM (where our program will start) and two temporary storage places at memory addresses 06 and 07. We use TEMPL (06) and TEMPH (07) to hold the address of the first character in the string.

Line 7 tells the assembler where the program will reside in memory (origin of code). Lines 8 to 23 initialize the registers and memory locations. In line 8 the instruction JSR jumps to the BASIC subroutine that gets the address of the string descriptor,

cessors use the bytes in that order. The particular way we retrieve the three bytes in the string descriptor and use them to perform the conversion differs for each computer.

Next, we look at each version of BASIC to see which statements let us execute assembly-language programs. Each version has different requirements for calling and returning from the assembly routine, as well as for passing information to that routine.

We then find a place in memory where we can put our routine to avoid conflicts with BASIC or other programs. On the three computers discussed here, we put the routine at the top of user memory, although the address of the area and the way it is set aside differ according to the version of BASIC being used.

Only after we take care of these preliminaries can we begin to work on the assembly-language routine itself.

How the Programs Work

In all three programs we place the location of the string in certain reg-

putting the LSB in register A and the MSB in register Y. Using the stack and register X for temporary storage, lines 9 through 22 then move the LSB of the address into TEMPL, the MSB into TEMPH, and the length of the string into register Y. Line 23 decrements register Y to point to the last character in the string.

Lines 24 to 32 convert the string by loading each character and converting it to lowercase if it is an uppercase letter. Line 24 labeled LOOP loads register A with a character using the value in Y added to the address in TEMPL and TEMPH. Then in line 25 the character in register A is compared with an uppercase A, and flags are set if the character is less than A. In line 26 we use the pseudo-opcode BLT (branch less than) and the operand SKIP. If the character is less than A, the program branches around the conversion routine to line 31, labeled SKIP. Lines 27 and 28 compare the character with Z+1; BGE in line 28 means branch if the character is greater than or equal to Z+1.

If the character in A is uppercase, line 29 converts it to lowercase, and line 30 stores the character in register A back in the string. Line 31, labeled SKIP, decrements register Y and branches back to LOOP if register Y is greater than or equal to zero. If Y is less than zero, the conversion is finished and the program goes to line 33 to return to BASIC.

After you type in the object code and save it on disk, type in the BASIC program. In this program, lines 20, 30, 40, 60, and 110 interface the assembly-language routine with the BASIC program. To protect our routine, line 20 sets the maximum address BASIC will use. Lines 30 and 40 set up the address of our routine for the & statement in line 110. Line 60 loads the machine-language routine into memory. Finally, line 110 calls the routine to convert the string S$ to lowercase. Lines 160 to 180 perform the conversion in BASIC.

```
                     1   *REM CONVERT A STRING TO LOWER CASE
                     2   STPTR   EQU  $DFE3
                     3   HIMEM   EQU  38300
                     4   TEMPL   EQU  $06
                     5   TEMPH   EQU  $07
                     6   *
                     7           ORG  HIMEM
959C:   20 E3 DF     8           JSR  STPTR
959F:   85 06        9           STA  TEMPL
95A1:   84 07       10           STY  TEMPH
95A3:   A0 00       11           LDY  #$00
95A5:   B1 06       12           LDA  (TEMPL),Y
95A7:   48          13           PHA
95A8:   C8          14           INY
95A9:   B1 06       15           LDA  (TEMPL),Y
95AB:   AA          16           TAX
95AC:   C8          17           INY
95AD:   B1 06       18           LDA  (TEMPL),Y
95AF:   85 07       19           STA  TEMPH
95B1:   86 06       20           STX  TEMPL
95B3:   68          21           PLA
95B4:   A8          22           TAY
95B5:   88          23           DEY
95B6:   B1 06       24   LOOP    LDA  (TEMPL),Y
95B8:   C9 41       25           CMP  #'A'
95BA:   90 08       26           BLT  SKIP
95BC:   C9 5B       27           CMP  #'Z'+1
95BE:   B0 04       28           BGE  SKIP
95C0:   09 20       29           ORA  #$20
95C2:   91 06       30           STA  (TEMPL),Y
95C4:   88          31   SKIP    DEY
95C5:   90 EF       32           BLT  LOOP
95C7:   60          33           RTS
```

```
10   HOME:REM APPLE LOWERCASE CONVERT DEMO
20   HIMEM:38300:REM 64K APPLE
30   POKE 1013,76:POKE 1014,(38300 - INT (38300 / 256) * 256)
40   POKE 1015, INT (38300 / 256)
50   ST$ = "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG"
60   PRINT CHR$ (4) + "BLOAD UPCASE.OBJ, A38300"
80   S$ = ST$ + ST$ + ST$ + ST$ + ST$
90   PRINT S$
110  & S$:REM THIS IS THE CALL TO OUR ROUTINE
130  PRINT S$
140  S$ = ST$ + ST$ + ST$ + ST$ + ST$
160  FOR X = 1 TO LEN (S$)
165  T = ASC ( MID$ (S$,X,1))
170  IF T = > 65 AND T < = 90 THEN T = T + 32
175  T$ = T$ + CHR$ (T)
180  NEXT
200  PRINT T$
999  END
```

isters and the length of the string in others. The program then loads the first character and sees if it falls in the range of A to Z and is in the correct case. If it isn't, the program converts it to the case we desire; otherwise the program skips the conversion.

We then get the address of the next character and check to see if all characters have been converted. If not, the program goes back and gets the next character. Once it has scanned and converted all characters, the program returns to BASIC.

Converting a character to uppercase or lowercase is done with one of two standard instructions. A logical OR instruction combined with the correct operand (20 hexadecimal) converts a character to lowercase. A logical AND instruction with the correct operand (5F hexadecimal) converts a character to uppercase.

For the Apple II and TRS-80 programs we used assembler programs to write the source code you see in the listings. For the IBM PC program we used the assembler included in the Debug program, a utility provided with PC-DOS version 2.1. This assembler lets you type opcodes and operands directly into memory.

Notice that the Apple II and TRS-80 source codes have three columns: labels, mnemonics, and operands. (To conserve space, we've eliminated the comments that help you keep track of what each section of the program does.) The IBM PC source code has only two columns: mnemonics and operands.

The first few lines in the Apple II and TRS-80 programs are called equates. These lines tell the assembler that the labels on the left equal the values on the right; they eliminate the need to remember specific numbers and make the program more readable. In the TRS-80 program, for example, the instruction AAA EQU 'A' lets us set the name AAA equal to the ASCII value of the letter A (41). Equates and data identifiers, such as DB for Define Byte in the IBM PC program, are called pseudo-opcodes. They are instructions for the assembler, not for the microprocessor.

For a detailed explanation of the rest of the programs, refer to the listing for your particular computer. Although we used assemblers to write the Apple and TRS-80 programs, you don't need assemblers to use them. The listings give you instructions on how to type in and run all three programs. We've included a simple BASIC program for each that executes the assembly-language routine. For comparison, the BASIC program also includes a short BASIC routine that performs the same operation as the assembly-language program.

One thing to keep in mind when looking at the source code listings is that some instructions refer to data itself and some refer to the address of the data. When dealing with addresses, an instruction is either calculating another address or retrieving data by using the address. For example, the instruction MOV CX, DX moves the data in register DX into register CX. But in MOV AX, [BX], BX holds the address of the data that will be moved into AX. For the Apple II, an instruction such as LDA 32 puts data at address 32 into register A, while LDA #32 puts the number 32 into register A.

Once you've typed in and run the program, try modifying it in different ways. For example, to convert characters to the opposite case, substitute the AND and OR instructions mentioned earlier.

A Few Guidelines

The procedures for writing different types of assembly-language programs vary so greatly that it's difficult to offer a single, surefire approach. However, a few general rules apply.

You must always decide where to put a routine in memory. Every computer has areas set aside for BASIC, the operating system, and other housekeeping programs. You'll have to read the documentation for your computer to see where your routine can be safely stored so that it does not affect and is not overwritten by other routines.

You'll also have to figure out which registers you can use for the input and output of your assembly-language routine. BASIC and your computer's operating system sometimes use the same registers that you want to use for your programs. You can alter some of these registers but you'll have to protect others. For example, you have to protect registers if they contain information you need to use in your routine. But suppose you need to use certain registers that should not be altered. In these cases, you'll have to temporarily store the contents of the registers

For IBM PCs: Converting a String to Uppercase

This program runs with BASIC on the IBM PC and converts all characters in a string to uppercase. The program uses the simple assembler built into the Debug program that is supplied with PC-DOS 2.1. If you don't have DOS 2.1, you can use the Enter command in Debug to type in the hexadecimal codes (shown in the last three lines of the listing from FD 00 to EF CB). The listing shows a typical session of assembling the program.

First, type DEBUG to start the Debug program. You'll see a minus sign when the program has loaded. Next type A 100 to tell the assembler to start generating object code at address 100. The addresses contain hexadecimal numbers (represented here by XXXX) separated by a colon from four more numbers. These hexadecimal numbers vary from one computer to another.

Now type in DB FD, DW F000 and so on to RETF, hitting Return after each. When you've finished, hit Return again to exit the assembler. Next, type D 100 123 and compare the hexadecimal codes displayed onscreen with those in the listing to check your work. If your object code is incorrect, you must retype the mnemonics.

If you type U 100 123, the Debug program disassembles the object code into source code, displaying the object code on the left and the source code on the right. (The first four lines you'll see are the data header that enables BASIC to load the routine. Since the disassembler does not know that those lines are data, it makes them appear as instructions. The object code for those four lines, however, is correct.)

when you begin to execute the routine and restore the contents when you leave the routine.

Finally, you must outline exactly what your routine must do and how you can do it. Three steps are essential in this phase: planning the flow of the program, deciding which registers to use for various tasks, and deciding how errors will be handled. Writing a flow chart will help you plan an efficient program. And after you see what kinds of counters, loops, and tests the program needs to perform, you can decide which registers to use. You can then think about the errors that might occur and how to handle them.

Tools of the Programmer

To carry out all these tasks, you'll need good documentation for your computer. This includes a memory map showing the areas available for your programs and descriptions of the computer's built-in routines that your programs can use as subroutines. These *—Continued on page 154*

After you've typed in the routine and checked it for errors, you must save it in a disk file. First put the length of the routine into register CX by typing RCX and hit Return. Debug will display the present contents, probably CX 0000. You then type 0025 and hit Return. Next, to give Debug the file name, type NUPCASE.BLD and hit Return. Finally, type W and hit Return, and Debug will save the file on disk.

As we mentioned above, the first four lines are the header BASIC needs for loading the object code. The USR statement initially passes the address of the string descriptor to register DX. Then the instructions in addresses 107 to 110 initialize registers with the length and address of the string so that CX holds the length of the string and BX holds the address of the first character.

Instructions from addresses 112 to 121 form a loop that converts the characters one by one, checking to make sure that they are lowercase letters from a to z and skipping them if they are not. The instruction at address 112 moves a character into register AL. Then the next two instructions compare AL with a lowercase a (61); if AL is smaller than 61, the program skips the conversion by jumping to address 120. The instructions at 118 and 11A test that the character is less than or equal to z; if not, the program skips the conversion routine.

If AL is a valid character, the instruction AND AL,5F at 11C converts it to uppercase. Then the instruction at 11E moves the converted character AL back to the string. The instruction at address 120 increments BX to point to the next character. In address 121 the LOOP instruction decrements the value in CX and loops back to address 112 to process the next character if CX is not equal to 0. The instruction RETF returns us to BASIC.

Now type in the BASIC program. Lines 20, 40, 60, and 110 interface the machine-language routine with BASIC. Line 20 sets aside an area in RAM from F000 to FFFF for the machine code. Line 40 sets up the address that USR0 will call, and line 60 loads the routine into memory at address F000. Line 110 calls the routine to convert the string in parentheses to uppercase. For comparison, lines 130 to 200 perform the conversion in BASIC.

```
A>DEBUG ------------ TYPE DEBUG
-A 100 ------------- TYPE A 100
XXXX:0100 DB FD -------- TYPE DB FD
XXXX:0101 DW F000 ------ TYPE DW F000
XXXX:0103 DW 0000 ------   AND SO ON . . .
XXXX:0105 DW 0030
XXXX:0107 MOV BX,DX
XXXX:0109 MOV CL,[BX]
XXXX:010B MOV CH,00
XXXX:010D INC BX
XXXX:010E MOV AX,[BX]
XXXX:0110 MOV BX,AX
XXXX:0112 MOV AL,[BX]
XXXX:0114 CMP AL,61
XXXX:0116 JB 120
XXXX:0118 CMP AL,7A
XXXX:011A JA 120
XXXX:011C AND AL,5F
XXXX:011E MOV [BX],AL
XXXX:0120 INC BX
XXXX:0121 LOOP 112
XXXX:0123 RETF                 . . . UNTIL HERE
XXXX:0124 ----------- TYPE RETURN TO FINISH
-D 100 123 ----------- TYPE D 100 123 TO CHECK
XXXX:0100   FD 00 F0 00 00 30 00 8B-DA 8A 0F B5 00 43 8B 07
XXXX:0110   8B D8 8A 07 3C 61 72 08-3C 7A 77 04 24 5F 88 07
XXXX:0120   43 E2 EF CB
```

```
10   CLS:REM IBM UPCASE.BAS
20   CLEAR ,&HF000
30   DEFINT X
40   DEF USR0 = &HF000
50   ST$="the quick brown fox jumped over the lazy dog."
60   BLOAD "UPCASE.BLD" ,&HF000
80   S$=ST$+ST$+ST$+ST$+ST$
90   PRINT:PRINT "STRING BEFORE CONVERSION TO UPPERCASE":PRINT
100  PRINT S$:REM PRINT STRING BEFORE CONVERSION
110  S$=USR0(S$)
120  PRINT:PRINT "RESULTS USING ASSEMBLY LANGUAGE":PRINT
130  PRINT S$:REM PRINT RESULTS
140  S$=ST$+ST$+ST$+ST$+ST$
160  FOR X=1 TO LEN(S$)
170  IF MID$(S$,X,1)=>"a" AND MID$(S$,X,1)=<"z" THEN
     MID$(S$,X,1)=CHR$(ASC(MID$(S$,X,1)) AND &H5F)
180  NEXT
190  PRINT:PRINT "RESULTS USING BASIC":PRINT
200  PRINT S$:REM PRINT RESULTS
```

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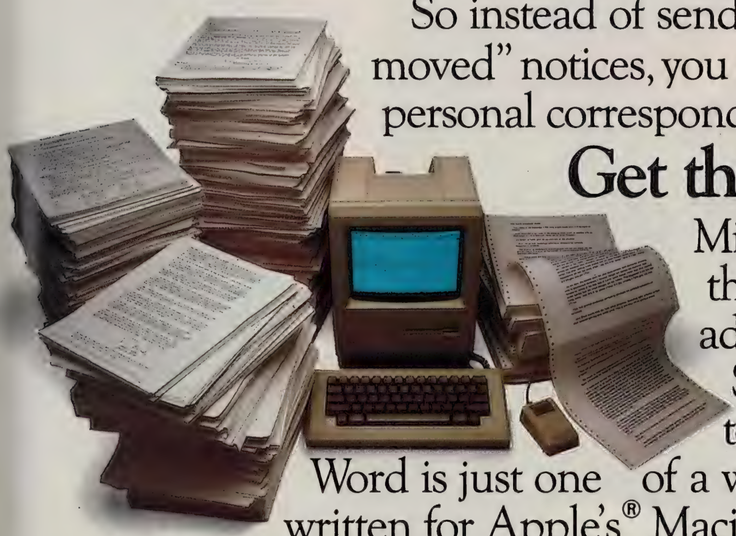

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Harry L. Brown
Senior Vice President/Publisher

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POPULAR REVIEWS

Wordstar 2000: surprising strengths and unexpected drawbacks

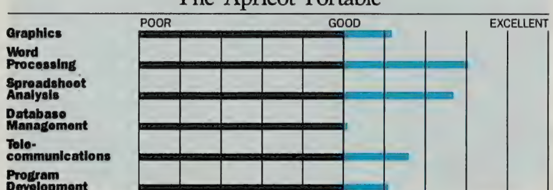
Hardware

Not every computer is right for every task. For example, an ideal system for word processing, with a keyboard that makes a typist feel at home, may not have the brute force needed to handle large spreadsheets.

To sort through the welter of options and conflicting claims, we've developed a method to chart the performance of computer systems in each of the six most used applications: word processing, telecommunications, database management, spreadsheet analysis, graphics, and program development. Fully 90 percent of each rating is derived from a comprehensive scoresheet that tallies the system's features; the remaining 10 percent represents our reviewer's subjective rating of how well those features are integrated.

AT A GLANCE

The Apricot Portable



Reviewer's Note: From a cordless mouse and keyboard to voice recognition, the Apricot Portable has an impressive array of features. You may not find them all useful, but they can be fun to use.

The results are displayed in a bar chart in the **"At a Glance"** box of every computer system review. We hope the new chart helps in choosing a system that's right for your personal and business needs. —DENNIS ALLEN

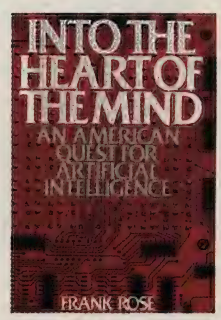
Software

While the MS-DOS world looked on in envy, Macintosh owners were awash in graphics splendor. MacPaint had become the new darling of micro users, and MacPaint artists of all ages and talents were blazing new trails. The only thing that consoled the green-eyed monster lurking in owners of IBMs and compatibles was that the Mac world is limited to black and white.

Now IBM owners can enjoy Mac-like capabilities in color. **ColorPaint** from IBM, **PC Paintbrush** from IMSI, and **PC Paint** from Mouse Systems imitate MacPaint. While none of these programs has the screen resolution or as many painting and picture editing options as MacPaint, they have enough features to allow our reviewer to recommend them on various accounts (on page 98).

On another front, Micropro has thrown its hat into the business word-processing arena with **Wordstar 2000** and 2000 Plus. Incorporating functions such as spelling checking, indexing, and telecomputing, Wordstar 2000 is aimed at new users in the corporate environment. Although similar to Wordstar, the new program, Micropro says, is more than an update. How much more is the question our reviewer addresses (on page 102).

—BEVERLY CRONIN



Books

A**rtificial intelligence** and expert systems are currently among the hottest topics in computerdom, and this fact has not been lost on book publishers. A spate of new books provide insight into this advanced realm, and this month reviewers Mike Nicita and Ron Petrusha give the interested reader some direction as they evaluate titles from Harper & Row, Addison-Wesley, MIT Press, and Wiley & Sons in "AI: from Myth to Money-maker," on page 126. —TOM MCMILLAN

PHOTOGRAPH BY DAVID BISHOP

The Apricot Portable

This sleek machine from Great Britain has all the extras, including voice recognition and a mouse

From its very look, you know this European import is different. Decked out in metallic black, the machine's LCD display swings out at a 45-degree angle from the system unit. A single microfloppy disk loads into a slot on the right side, behind a built-in microphone used for voice input. The keyboard and mouse, also clad in metallic black, stand apart with no clumsy wires needed to connect them to the machine.

Even in its most basic aspects, the British-made Apricot Portable differs from most other MS-DOS-based machines. The system is built around an Intel 8086 central processor—a more powerful version of the more common 8088. And as part of its standard equipment, the Apricot comes with 512K bytes of user RAM.

Indeed, the Apricot Portable's unique combination of trendy features makes it one of the most interesting new computers to hit the market this year. And this sporty little machine sells for about $2500.

Its manufacturer, Applied Computer Techniques (ACT), Britain's largest microcomputer firm, has tried before to enter the American market (see "The Apricot," *Popular Computing*, June 1984). That disastrous attempt was based on a marketing agreement with Micro D, a U.S. software distributor, which

sold only 110 of the British machines in 1984.

This time, ACT has set up an American affiliate, Apricot Inc., in Santa Clara to market the computers in the United States. Apricot will market its machines primarily through distributors that represented Apple before Apple changed over to its own network. And even with its modest $7 million advertising campaign, Apricot hopes that its new Portable can cut a piece out of Apple's pie.

High-Resolution Display

The Apricot Portable has a 25-line by 80-column LCD screen that has a resolution of 640 by 200 pixels. The screen has a greenish tint and sometimes reflects an annoying amount of glare, but it is readable.

The Apricot Portable can, however, use a color monitor. The machine has an RGB video output, and Apricot offers several optional color monitors. The Apricot Portable has 128K bytes of video RAM to support both the LCD and RGB displays. The large video RAM allows two choices for displaying color graphics: you can choose to display up to 8 colors simultaneously on an external monitor and still use the LCD, or use only the external monitor and display up to 16 colors at a time.

Large-Capacity Disk Drives

The machine's high-capacity drive uses double-sided 3½-inch microfloppy disks and is capable of storing 720K bytes per disk, about twice that of conventional 5¼-inch drives. And to remain compatible with the other Apricot computers, it can also format, read, and write 315K-byte single-sided disks.

But the larger-capacity disk drive isn't as easy to use as it should be. Most programs for the Apricot family are supplied on single-sided disks, but with only one disk drive it's difficult to transfer programs to a double-sided disk. First, the MS-DOS Diskcopy program requires two identically formatted disks. Second, Apricot's modifications to the Copy program allow you to copy only one file at a time, and copying

How Do I Choose the Right Personal Computer Monitor?

one file at a time and continually swapping disks is a time-consuming and frustrating process.

But there is a better way. The Apricot Portable includes a routine that makes the machine think part of its RAM is a disk drive, and you can use that RAM disk to store files and programs. By creating a RAM disk with half of the machine's 512K bytes of user RAM, you can copy the files from the single-sided disk into the RAM disk and then copy the files from the RAM disk to a double-sided disk. This process dramatically reduces the number of disk swaps.

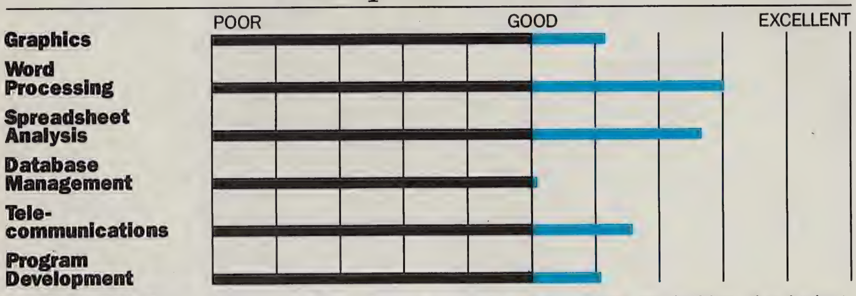
Aside from the hassles of copying files on a single disk drive, the large capacity of each double-sided disk is adequate for most applications. Apricot does not plan to offer an external second microfloppy disk drive, though it will offer the Mass Storage Device (MSD), an external 10-megabyte hard-disk drive.

Wireless Keyboard and Mouse

The Apricot Portable's stylish keyboard has a standard typewriter layout and a numeric keypad. The keyboard is made up of 92 "soft keys" any or all of which you can reprogram using software that comes with the machine. Missing is an Alt key, but a Stop key that freezes the screen display, a keyboard lock, and a Reset key have been added.

AT A GLANCE

The Apricot Portable



Reviewer's Note:	From a cordless mouse and keyboard to voice recognition, the Apricot Portable has an impressive array of features. You may not find them all useful, but they can be fun to use.
Manufacturer:	Apricot Inc., 3375 Scott Blvd., Suite 342, Santa Clara, CA 95051; (408) 727-8090
Standard Features:	5-MHz Intel 8086 central processing unit; 512K bytes of user RAM and 128K bytes of video RAM; single 720K-byte 3½-inch double-sided microfloppy-disk drive; 92-key programmable infrared keyboard; 32K bytes of boot ROM; RS-232C serial port; parallel printer port; color monitor port; carrying case
Included Software:	MS-DOS operating system, Activity shell, Speech Recognition System, Diary, Sketch, Supercalc, Superwriter, Superplanner
Base List Price:	$2495
Options:	Infrared mouse ($145); 128K-byte memory expansion board ($295); 256K-byte memory board ($495); Mass Storage Device—10-megabyte hard disk (price not set at press time)

Like the IBM PCjr, the Apricot Portable's keyboard is battery-powered and uses infrared light to send signals to the system unit. The keyboard has two emitters that send the signals as 32-bit codes in microsecond pulses. The pulses are picked up by a special wide-angle lens on the system unit.

To avoid infrared interference when two or more Apricot Portables are being used in the same room, the company includes a "light pipe," a thin, flexible 1-meter fiber-optic cable that connects the keyboard to the system unit.

What's most important is that the Apricot Portable's infrared link works better than others I've seen. The secret lies in the 32-bit codes and the wide-angle lens, which picks up signals at up to about a 90-degree angle. Apricot rates the keyboard with a range of 2 meters (about 6 feet). In practice, however, the keyboard performed well from 12 feet across a room. But I'm not convinced that range is necessary, because you can't read the LCD from far away.

Beyond the chic infrared keyboard, the Apricot Portable supports a tailless mouse. The optional pointing device ($145) is battery-powered and uses the same infrared technology as the keyboard, and it works just as well. The Apricot mouse is unusual in yet another way; it consists of a black box with a ball that protrudes out of both the top and bottom. You can either tilt the unit forward and roll it around as a mouse, or keep it flat and stationary and use it as a trackball—Britain's preferred pointing device.

Voice Recognition

If you're not dazzled by the keyboard and mouse, then the fold-out microphone could grab your attention. The microphone is controlled by software that lets you use voice commands. When activated, the voice system takes up 55K bytes of user memory and requires training the computer. The training is done by repeating several times the words and phrases you wish to use and typing their meanings for a particular program. Afterwards, whenever you run that program, the voice-recognition system effectively types in the words it recognizes.

The system includes a program called Diary that keeps track of your appointments, and it has a speech vocabulary. You can easily set up vocabularies that make speech input work much like function keys for other programs.

Compared with some other voice-recognition systems, the Apricot's is limited. It can recognize up to 64 words or phrases at a time, and it can have a total vocabulary of 4096 words stored on disk. But the Apricot Portable can recognize only single, isolated phrases—not words said in the middle of a sentence; and generally it is not as accurate as more sophisticated systems, such as

the Texas Instruments Speech Command System. I found it easier (and more accurate) to simply type in the commands I wanted. Still, the voice system is fun to use with a program, such as Diary, that's designed for voice input. Besides, TI's Speech Command System costs $1500 while the Apricot Portable includes this feature.

The Apricot Portable also comes with two ports for input and output, including a Centronics-compatible parallel port and an RS-232C serial port. Though these ports use the same standard protocols as most American computers, they require different cables than the IBM PC and most other MS-DOS computers.

The machine also has a single expansion slot that can be used to add 128K- or 256K-byte memory expansion boards ($295 and $495 respectively), allowing you to address memory up to 768K bytes, or a hard-disk controller. Because the Apricot Portable has only one slot, however, you cannot have both the maximum memory and a hard disk.

Bundled Software

The Apricot comes with a variety of software. When you first turn on the system, you see Activity, an MS-DOS software "shell" that provides a mouse-driven, icon-based environment, which looks a bit like the operating environment used on Apple's Macintosh. Through Activity, you can format, read, and copy disks or run an applications program. If you don't have the optional mouse, you can use the numeric keypad to move the cursor.

Activity is easy to learn. If you're familiar with MS-DOS, though, you might prefer to just type in MS-DOS commands, rather than searching through menus of icons. Unfortunately, the Apricot does not come with the standard MS-DOS commands necessary to format a disk or transfer the operating system, so you're stuck with Activity.

Apricot has announced plans to offer Digital Research's Graphics Environment Manager (GEM), another shell that's easy to use and more closely resembles the operating en-

Will It Work with My PC?

Before you can experience the full capabilities a high performance monitor offers, it has to work with your personal computer. That's why Princeton Graphic Systems makes high resolution monitors compatible with most popular brands of personal computers. IBM, Compaq, Corona, Apple and more. But we go one step further. By paying close attention to ergonomic detail, we make Princeton Graphic Systems monitors compatible with you, the computer system user...

vironment used on the Macintosh. At the time of this writing, the firm hadn't decided whether to include GEM with the machine or offer it as an option.

The Apricot Portable also gives you several enhancements to MS-DOS, including utility programs that let you edit the character fonts and icons displayed on the screen and reprogram the keyboard.

In addition, the machine comes with other useful programs. One called Tutor supplements the documentation and provides an overview of how both the computer and Activity work. Sketch is a mouse-driven graphics program similar to MacPaint, the popular graphics program for the Macintosh. If you have a color monitor, you can even use Sketch to draw in color. Also bundled with the system are Sorcim's Supercalc, Superwriter, and Superplanner—adequate and fairly typical spreadsheet, word-processing, and planning software.

Because ACT designers did not want the Apricot Portable to be just another clone of the IBM PC, they gave up full software compatibility with the IBM world. However, Apricot plans to offer an asynchronous communications package for the Apricot Portable and the IBM PC. The communications package will allow you to transfer files between the two machines via their serial ports despite the differences in the disk drives.

Apricot claims that about 500 applications programs, including Lotus 1-2-3, will be available for its machine. Already, Supercalc III (an advanced version of the spreadsheet that comes with the machine that includes graphics), Wordstar, dBASE II, and others are available. At a January press conference, Ashton-Tate, Microsoft, and Software Publishing announced that they would be developing software for the Apricot line.

Questions

While ACT has been successful in delivering software in the United Kingdom, it's yet to be seen whether Apricot can have similar success in the domestic market. Certainly, you will not have as many program choices for the Apricot as the IBM PC, but you should have enough to cover all the major applications.

You also have to wonder how "portable" this machine really is. Apricot's claim to portability is based on selling the machine with a hard plastic carrying case. Though the system weighs only 13 pounds, by the time you add in the case and the mouse, you've got a 20-pound machine. That's nearly the weight of a typical transportable, such as Compaq's, which includes a CRT monitor that is much easier to read than the Apricot's LCD.

And then there's all those special features. Many of the Portable's best features are merely gimmicks. The LCD seems unnecessary on a machine that isn't truly portable; you don't really need an infrared keyboard or mouse; and little applications software takes advantage of either the graphics or the voice recognition. But given the Apricot Portable's $2500 price tag, it's difficult to criticize the fancy extras. And let's face it, all those gimmicks give the Apricot its sex appeal.

That's important, because Apricot's target audience is largely those people who buy fancy sports cars when a sedan will do. This strategy neatly sidesteps IBM and puts the firm directly up against Apple. That's not too unusual—both Polo Microsystems and Mad Computer had similar goals in mind when they, too, introduced stylish machines. But Apricot seems to have better financing and better distribution, and it may well succeed where others have failed.

—MICHAEL J. MILLER

Michael J. Miller is a West Coast editor of *Popular Computing.*

The Visual Commuter

A new answer to the portability equation

Computer makers are deeply concerned about the problem of "taking it with you." No, they're not talking about wealth after death, but personal computers you can pick up and carry.

Attempts at portability, however, stumble over the fact that display screens and keyboards must retain some human scale. But with the

PHOTOGRAPH BY LARRY LAWFER

Visual Commuter, the equation is solved a different way—the display screen has been dispensed with. And, surprisingly, this omission makes sense.

The $1895 basic unit is compatible with the IBM PC and comes with Microsoft's MS-DOS 2.1 and GW BASIC, 256K bytes of RAM, two 5¼-inch floppy-disk drives, but no screen at all. It does, however, have a video port to which you can plug a monochrome or color monitor. The idea is that you could have one monitor at the office and one at home (or wherever) and carry only the computer back and forth. But if you spend more time someplace in between, you can fall back on either a 16- or 25-line optional LCD screen that costs an additional $395 or $695 respectively.

The Broad Briefcase Look

When packed, the Commuter looks like a metal briefcase that's somewhat broader than average. It's 18 inches wide, 15½ inches deep, and 3½ inches thick. With the optional LCD screen, the Commuter weighs about 20 pounds. Of course, that's not exactly a featherweight package, but I've carried heavier briefcases. A sturdy hinged handle encased in hard rubber eases the job of carrying the Commuter.

At the back of the unit are six I/O ports—an expansion port, an RS-232C serial port, a programmable serial port, a parallel printer port, a monitor port, and a composite video port. To use the machine, you lay it down with the handle toward you, push the latches on either side, and swing the keyboard cover up on its hinges, revealing the keyboard and disk drives.

If the unit is equipped with the optional LCD screen, you'll find it built inside the keyboard cover. Dangling from the LCD will be a cord with a modular plug, which you plug into a receptacle above the keyboard.

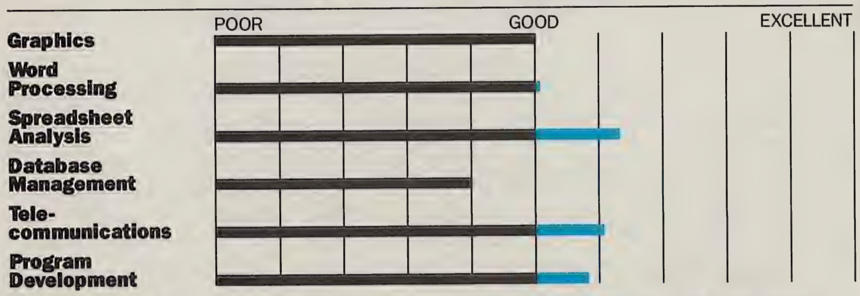
Most of the other portables on the market are briefcase-sized or smaller. But a glance at the Commuter's keyboard shows one reason why the Commuter is bigger—the keyboard is a full-size replica of the

Does It Give Me A Bright, Sharp Image?

Take a close-up look at the display. Bright, crisp characters and sharp, colorful graphics mean you're getting a high-quality image. The kind of image that comes with every Princeton Graphic Systems' monitor. Because Princeton Graphic Systems combines flicker-free technology, a fine dot pitch, and a nonglare screen to give you an image that *PC World's* World Class Survey rates number 1 . . .

AT A GLANCE

The Visual Commuter



Reviewer's Note: Even though it's a bare-bones transportable hardware configuration, the Commuter offers the potential for high-level communication, and its processing throughput speed is better than that of the typical IBM PC clone. Using its optional 16-line LCD may be a hindrance with most software, but a standard monitor, black-and-white or color, works well with the system.

Manufacturer:	Visual Technology, 540 Main St., Tewksbury, MA 01876; (617) 851-5000
Standard Features:	8088 microprocessor, 256K bytes of RAM, two 360K-byte 5¼-inch disk drives, integral keyboard, expansion port, two serial ports (one programmable), one parallel port, one monitor port, and one composite video port, MS-DOS 2.1, and GW BASIC
Base List Price:	$1895
Documentation:	Operator's Guide/DOS manual, BASIC manual
Options:	Additional 256K bytes of RAM ($450), 16-line LCD ($395), 25-line LCD ($695), RS-232C communications chip ($125), 8087 coprocessor ($275)

IBM PC keyboard. Most of the other portable manufacturers have made their keyboards smaller by putting the function keys along the top and doing away with a separate numeric keypad.

Above the keyboard are two 5¼-inch floppy-disk drives. Each drive stores the standard 360K bytes on a disk using the MS-DOS 2.1 operating system.

Dividing 25 by 16

My evaluation unit came with the optional 16-line by 80-column LCD screen measuring 2½ by 9½ inches. But a 16-line screen presents a few problems. The standard IBM PC screen has 25 lines, and most software written for the IBM PC requires all 25 lines. To address this situation, the Commuter system outputs 25 lines of data but displays only 16 of those lines on the LCD at once; it keeps track of the rest in memory.

You can scroll up and down as if the 16 lines on the LCD were a "window" on a 25-line display. Pressing CTRL-ALT-P causes the window to jump to the top or bottom of the 25-line "screen." Pressing CTRL-ALT and either the plus or minus key causes the window to scroll one line up or down. Oddly, however, only the plus and minus keys on the top row of the keyboard work for this function—the plus and minus keys in the numeric keypad do not.

This window feature worked fine while I was in BASIC or the system level of MS-DOS. But the moment I started using my word-processing program (the Leading Edge Word Processor), I ran aground. The software intercepted all the keystrokes, and because it did not understand the Commuter's window commands, it just beeped and gave me an error message.

Meanwhile, in the act of painting the display, the window had traveled to the bottom of the 25-line screen and remained there. I needed to select a menu item from a list located at the top of the screen, but I couldn't see the top because neither the CTRL-ALT-P command nor the other two scroll commands worked from within this software.

I complained, and an engineer at Visual told me about a command that kept the window at the top of the screen—but then I couldn't see what was happening on the bottom nine lines.

But two considerations keep me from taking the problems of the LCD screen seriously. The first is that the screen is obviously there just as a stop-gap—something to use when you can't get a "real" monitor. The second is that Visual Technology offers a 25-line bit-mapped LCD screen that it says will support IBM PC-compatible graphics of 640 by 200 pixels. However, this screen was not available at the time of this writing.

In the meantime, the Commuter's monitor port supports either a monochrome or color monitor. When I tried the machine with a monochrome monitor I discovered that there was no on-screen underlining. According to Visual, the original production run of the Commuter does not support that feature, but subsequent models will. Connected to an IBM color monitor, however, the Visual Commuter performed well.

Peeking Inside

The Commuter can hold up to 512K bytes of RAM. However, the IBM PC and most compatibles can hold up to 640K bytes of RAM, although only a few applications programs require that much user memory.

As for other options, inside the unit you'll find two empty chip sockets (assuming all 512K of bytes RAM are present). The first is for an 8087 arithmetic coprocessor, which can greatly increase the number-crunching power of the 8088, assuming you have software that will invoke it.

The second socket is for an 8530 communications chip. This will allow you to use the programmable serial port so that the Commuter can communicate with most mainframe computers. The port is not functional without the chip, which Visual sells for $125. Visual, however, does not offer any software for the port.

Benchmark programs showed that the Commuter operates a little faster than I expected. Even though

it runs at the same 4.77-MHz clock speed used by the IBM PC, its single-board circuitry makes it 8 to 10 percent faster.

When you boot the system with no system disk in the drive, the system displays a menu that allows you to perform diagnostics or put the machine in terminal mode, which is used when the Commuter is connected to another computer. The menu also lets you change the terminal parameters, such as baud rate, parity, and so forth, or load the operating system.

The Big Picture

The portable market has become a sizable subset of the entire personal computer industry, ranging from transportable units like the Compaq down to kneetop items like the Radio Shack Model 100. The transportable types generally rely on standard CRT monitors and so remain too bulky for true portability. The kneetop systems have achieved true portability but don't pretend to do everything their bigger cousins do.

And in between are systems like the Commuter—fully functional systems that rely on LCD screens to keep the weight down. Even in this niche you'll find a wide range of offerings, such as the Data General One machine with an 80 by 25 LCD, or the Hewlett-Packard HP-110 with an 80 by 16 LCD screen and Lotus 1-2-3 in ROM, or the Morrow Pivot, or the Sharp PC-5000, or the Grid Compass, and so on.

Most of these portables use 3½-inch microfloppy disks—if they use disks at all. And so far, little software is available in that format. With the Commuter and its standard 5¼-inch disks, you are free to buy off-the-shelf software. And the Commuter's price, compared to the other systems, is competitive, especially since it has built-in circuitry that supports color graphics (that's usually an extra-cost option). The Commuter is indeed a viable answer to the portability equation.

—LAMONT WOOD

Lamont Wood is a freelance writer who lives in San Antonio, Texas.

How About Dependability?

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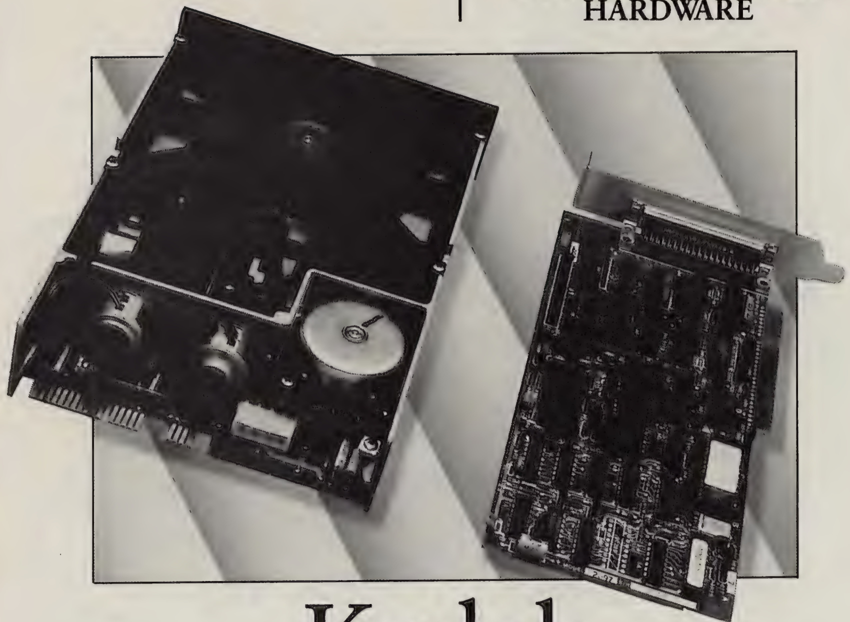


Kodak 3-Megabyte Disk

The Teammate 1103 adds mass storage to your IBM PC

Kodak may not be the first name that comes to mind when you think of mass storage for your computer, but the company's long experience in other high technologies allowed Kodak to enter this field in an impressive fashion: its new high-density floppy-disk subsystem, the Teammate 1103, is a half-height 5¼-inch drive that can store a whopping 2.78 megabytes of information on special disks. Teammate works with IBM PCs, XTs, ATs, or compatibles that use PC-DOS or MS-DOS version 2.0 or later.

Kodak began work on Teammate when company scientists developed a new material that could be used in very-high-density floppy disks. However, existing hardware couldn't make good use of the new floppies' capacity, so Kodak decided to manufacture both the new disks and the drives to use them. The one component Kodak chose not to produce is the controller board. This is made by Data Technology, a firm in which Kodak owns a 25 percent interest. Data Technology also is handling the marketing of the complete drive subsystem—disks, drive, and controller board.

The Components

For $945 the Teammate gives you one 5¼-inch floppy-disk drive, an IBM-PC-compatible disk controller card, a cable, one high-density floppy disk, mounting hardware, a backup program called Bakup, and a manual. The drive is the same size and has the same mounting holes as a regular half-height drive. The 8-inch controller card occupies one expansion slot in an IBM PC or compatible.

Bakup is essentially an improved version of the PC-DOS backup utility. This slick program cuts the usual two-hour backup of a 10-megabyte hard disk to less than half an hour. Other improvements include selective backup of single files, maintenance of a file database containing backup information, and backup history reports.

On the outside the Teammate drive doesn't look much different from a conventional half-height floppy drive. There is a push button for ejecting the disk and a lever for closing the disk drive that slides parallel to the disk slot.

But on the inside are two positioning motors for the read/write head. To get the high-precision positioning required, one motor moves the head in relatively large steps, while the other does fine tuning. The Teammate crams 192 tracks of data into the same one-inch space in which conventional floppy-disk drives put only 48 tracks and the high-capacity drives in the AT put 96. Because the Kodak drive uses a much narrower track width than a regular floppy-disk drive, tracks written by the Kodak drive cannot be read by standard IBM disk drives.

However, one of the most interesting features of the Teammate is that it can read regular disks created on the IBM PC (either 320K or 360K bytes). This allows the Kodak drive to be used in place of a conventional floppy-disk drive for read-only disk compatibility with the PC.

The controller card can handle a number of different configurations. You can use it alone to control your system floppy-disk drive, the Teammate drive, and a hard-disk drive. This option is particularly useful if you're running out of open expansion slots. Otherwise, the Data Technology controller can be used side by side with your present floppy-disk controller and an XT or AT fixed-disk controller. The determining factor on which configuration you use may be the power supply in your system. The XT and AT power supplies can handle two floppy-disk drives in addition to their fixed disks, whereas the standard PC can handle only two floppy-disk drives.

Once you've decided which way to configure your system, the real work begins. The 56-page manual de-

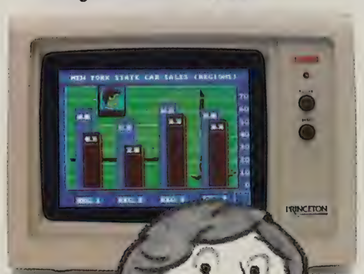
PHOTOGRAPH BY LARRY LAWFER

Meet The Princeton Graphics Systems Family.

The right monitor at the right price. Princeton Graphic Systems offers you a complete family of high performance personal computer monitors. Monitors that deliver the compatibility, resolution, and reliability you need for any application and any budget: from word processing to sophisticated business graphics.

HX-12. High resolution RGB monitor -690 x 240 lines noninterlaced -.31 mm dot pitch tube-Nonglare screen -**$695**

HX-12E. High resolution RGB monitor -Compatible with IBM Enhanced Graphics Adapter -Nonglare screen -**$785**



MAX-12. Amber monochrome -720 x 350 lines -Enhanced to interface with IBM color or monochrome adapter card -Nonglare screen -Can display 16 shades of amber -**$249**

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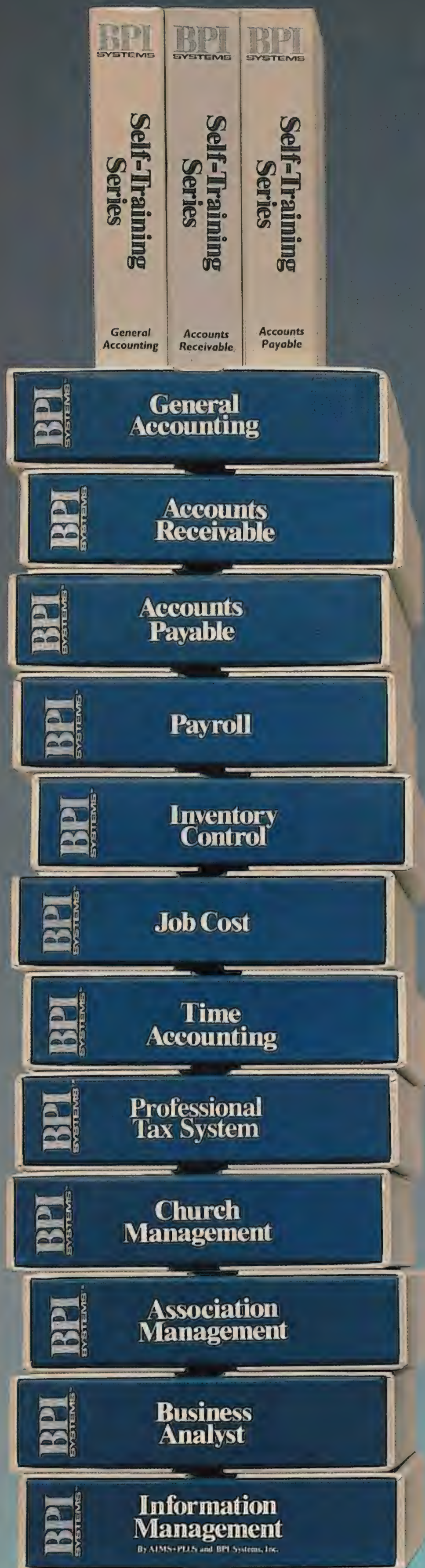

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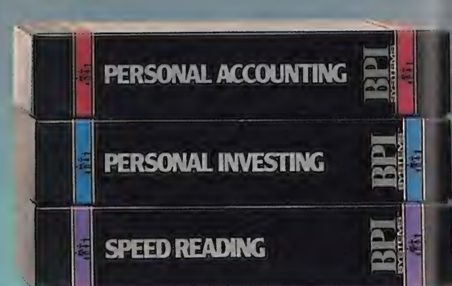

Inquiry 75

scribes installation of the Model 1103 Kodak drive. However, it's probably best to have the drive installed by a qualified technician because there are many possible pitfalls along the way, and the manual isn't always clear. The company says the manual is being reworked extensively.

If you do decide to go it alone, you have several tasks to perform. In a nutshell, you have to set jumper wires on the controller card and drive, physically install the controller and drive, and connect the cables. If you are using the DTC controller to manage your system floppy drive, you may have to remove it to change jumpers as well. It's a good idea to test the system before you mount the Kodak drive. The cable provided is long enough that I was able to run everything with the drive lying on top of my computer.

Using the System

Booting the system is handled by a ROM chip on the controller and results in some messages that surprised me. The first warns of a Data Technology 1110 Winchester disk failure, which had me worried until I remembered I didn't have one. Then a message informs you that the Kodak disk is being initialized. After that, the system functions as before.

You must initialize (using PC-DOS or MS-DOS) each new Kodak floppy disk just like a new hard disk. The FDISK program partitions the disk, and FORMAT, of course, formats it. If the "/s" option is selected with FORMAT, the system information is written to the Kodak drive, allowing your computer to default to it (on PC XTs and ATs, the fixed disk remains the default drive).

The Kodak drive is assigned the highest two drive letters in the system. The highest letter refers to the Kodak drive in the high-capacity mode, and the next lower letter refers to the Kodak drive in the IBM-floppy-compatible mode. In other words, if you have a Kodak drive and one system floppy, the system floppy is drive A. A high-density Kodak disk in the Kodak drive is accessed as drive C, and a regular disk in the Kodak drive is drive B. You must refer to the different disks by the correct letter. If you make a mistake, for instance by referring to a high-density disk by the wrong drive letter, the system responds with a PC-DOS disk failure message."

To test the performance of the Kodak drive against similar drives, I ran a series of benchmarks. The benchmark programs tested the disk drive's performance in two areas: how fast it moves the head, and how fast it can read data.

In one test, the head is positioned and the program times how long it takes to read the given number of consecutive sectors. The Teammate was consistently faster than the standard floppy-disk drive but much slower than the IBM fixed disks.

In another series of tests, a number of sectors are read, the head is moved a fraction of the total disk width, the same number of sectors are read again, and so forth. In these tests, the Kodak drive was about 20% slower than the floppy-disk drive; the complicated head-positioning system in the Kodak drive is slower than that in a standard floppy-disk drive even though the data transfer rate is faster. Using Lotus Development's 1-2-3 and Micropro's Wordstar, however, I found the speed difference between the Kodak drive and the 360K-byte floppy-disk drive to be negligible.

Where you might notice a difference would be in an application such as a large database; if the database is accessed sequentially, requiring less head positioning, the Kodak drive would be faster than a floppy, whereas random accesses would most likely be slower.

Value for the Money?

The biggest point in favor of the Teammate is versatility. If you have only one floppy drive, it adds both another floppy drive (read only) and high-capacity storage. If you have an XT or AT, it adds a far more convenient means of backup than conventional floppies.

AT A GLANCE

Teammate 1103 Disk Subsystem

Manufacturer:	Data Technology Corp., 2775 Northwest Parkway, Santa Clara, CA 95051; (408) 986-9545
Uses:	Mass storage for IBM PC, XT, AT, and compatible computers
Standard Features:	5¼-inch disk drive with 192-track-per-inch read/write format that stores 2.78 megabytes of data; two-motor head-positioning system; disk controller card; cable; one high-density disk, and a backup utility program, called Bakup
Documentation:	56-page owner's manual
Options:	Blank disks ($15 each)
Base List Price:	$945
Reviewer's Note:	The combination high-capacity and 5¼-inch floppy-disk factors make the Teammate 1103 unique in the market. With nearly 3 megabytes of storage, it stacks up well against other floppy-disk drives and tape backup devices competing for space in your system.

And the Teammate gives you the ability to carry an enormous amount of data in your briefcase. Ten Kodak disks can hold nearly 30 megabytes of information.

But the question of whether to choose the Kodak system or a fixed disk is complex. The prices I've seen for some PC XT-compatible 10-megabyte hard-disk subsystems are about the same as that of the Teammate. The Kodak drive is slower and has less capacity than most Winchester subsystems, but the problems with making backups are fewer. And anyone who has spent two hours backing up an XT hard disk onto 28 floppies can testify that the latter is a considerable advantage.

—DAVE GARLAND

Dave Garland is a freelance writer who lives in Parsippany, New Jersey.

The Penpad 320

This digitizer lets you enter data in your PC the old-fashioned way—with a ballpoint pen and paper

For thousands of years there was only the handwritten word. Then came the typewriter, followed by word-processing computers with typewriter-style keyboards. Now we've come full circle with Pencept's Penpad 320, a digitizing pad for the IBM PC and Compaq computers that's so sophisticated it can understand your handwriting. But Penpad's character-recognition capabilities are hardly a step backward.

Penpad sells for $1495 and consists of a digitizing pad, a pen with special circuitry, and an expansion board for the computer. The pad itself is large (16 by 17 by ⅜ inches) and weighs about 6 pounds—too bulky for lap use but highly stable on the desk. The pad provides an 11-inch square work area, larger than that available on most digitizing or graphics pads. An adhesive strip at the top of the work area tacks down special command templates and graph-paper work sheets.

The pen writes in ink on the graph paper and takes a standard ballpoint pen refill. A coil within the pen produces a weak magnetic field that is picked up by the pad. Power for the pen is supplied by a narrow cord that connects the pen to the top of the pad, and a button on the side of the pen is used like the Enter key on a keyboard or like the button on a mouse. In fact, you can use the pen much like a mouse for cursor control by pressing the button and gliding the pen half an inch or so above the pad until the cursor reaches the screen position you want. The Penpad "knows" when it's actually in contact with the pad through a second, inner switch that's activated when you bear down on the point.

Inside the pad are rows of coils, placed about a quarter inch apart, that sense and measure the magnetic field emitted by the pen. The Penpad's special driver program determines the pen's location by comparing the strength of the pen's signal at each coil; the closer the pen is to a given coil, the stronger the field appears. The pen's location is checked 100 times per second, and the information is transmitted to the computer serially at a rate of 9600 baud through a cord that plugs into a port on the Penpad expansion board.

A Motorola 68000-10 microprocessor on the Penpad board provides quick data handling, and two on-board communications chips take care of data transfer between pad and computer, leaving your computer's serial port free for other uses. The board includes 128K bytes of ROM devoted to the Penpad's sophisticated control and character-recognition program, and 64K bytes of RAM dedicated to Penpad's buffer and other memory needs.

Writing with Penpad

Penpad's character-recognition ability is outstanding. To most digitizers, a number or letter written on the pad is just a squiggle to be faithfully copied to the screen, but Penpad actually diciphers the squiggles and interprets them as numbers and letters. Anyone who's not a world-class typist can use Penpad to enter data quickly and accurately without needing to master new skills.

More important, Penpad is surprisingly tolerant of different hand printing styles, though it can't read cursive script. This is because the pad interprets a character not only by looking at the completed shape, as optical text readers do, but also at the sequence of strokes used in creating it. For example, since most people in our society create letters from left to right and top to bottom, Penpad will not recognize a "Z" started at the bottom right. This means that most people can begin using Penpad with a minimal amount of training.

However, some characters are more difficult to interpret than others. The pad may mistake a left parenthesis for the letter "C" or the number "1" until you adjust your writing style to fit its expectations. Unless you're working in an area designated specifically for letters or for numbers, you'll also need to differentiate between letters and numbers that resemble one another, such as "I" and "1," or "O" and "0." Penpad will make a guess in many cases, but if it can't, it will put a question

PHOTOGRAPH BY BILL BUCKLEY

mark on the screen instead; writing over the incorrect character will change it. Each character you print must be placed roughly within one of the graph-paper squares, although Penpad recognizes letters somewhat larger than the indicated size. When entering text in response to a non-graphics program prompt, it doesn't matter where on the pad you begin to write. The text will automatically appear on the screen at the cursor location.

Business Applications

The ability to recognize printed handwriting makes Penpad appropriate for some tasks that ordinary digitizing or graphics pads couldn't attempt. One of these is transferring information from forms to a computer, especially where retraining employees to enter the information directly into the computer would be costly. This was the case at Blue Cross and Blue Shield of South Carolina, where Penpad has improved both the speed and the accuracy of transferring data from insurance claims forms to the computer.

Prior to using Penpad, Blue Cross used specially trained coders to check incoming claim forms against the physicians' written descriptions of medical procedures. The correct codes were entered onto a separate paper form that went to the data-processing department where keyboard operators entered the information into the computer.

Now, using Penpad and a paper form much like the one already in use, the coders *write* the data into the computer themselves, eliminating an entire step from the data-entry process. It took only an hour for coders to learn to use the new system accurately.

You can also use Penpad in graphic arts. It combines the best features of a joystick, mouse, and light pen. And yet, because Penpad lets you work with pen and paper in the usual way, there's no need to develop the new coordination habits required by mouse or joystick. You can even trace existing images, a technique that's difficult with a light pen or mouse and impossible with keyboard and joystick. If text entry is necessary, either for issuing commands to the art program or for putting text on the screen, Penpad lets you enter the text quickly without leaving the pad. What's more, because Penpad's large work area is roughly the same size as the screen, you don't need to be a miniaturist to get pleasing results.

As a graphics tool, Penpad appeals to amateur and experienced artists alike. Dr. Nat Mody, an associate pathologist at Chicago's Memorial Medical Center, uses Penpad to create educational "slide shows" for medical students; Dr. Mody also creates the text screens that explain the slides with Penpad. At the other end of the artistic spectrum is Alan Zenrich, a professional artist who uses Penpad in his New York City studio to produce special effects for advertising, such as tracing actual photographs to create a computer-

AT A GLANCE

The Penpad 320

Manufacturer:	Pencept Inc., 39 Green St., Waltham, MA 02154; (617) 893-6390
Standard Features:	Pad comes with pen, expansion circuit board, Pendraw art software, Penform data-entry software, 1-2-3 Penpack software interface, Software Tool Kit (lets users design software)
Base List Price:	$1495
Documentation:	Spiral-bound user's manuals for the hardware and for each software package
Options:	Penpack software interfaces for Multiplan, Wordstar, and IBM Personal Editor ($50 each); Videogram high-resolution art software ($300)
Reviewer's Note:	The Penpad is the first digitizing pad that can read handwriting, and it represents a significant step forward in improving human-computer interface

Inquiry 5

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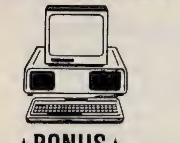

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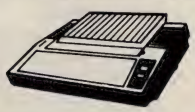

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ized enhancement of a scene that can then be superimposed on the original photograph.

Applications Software

The basic Penpad driver program works well with most applications software. In this mode, the computer treats characters you write on the pad exactly as if they were entered on the keyboard. In fact, the only drawback to using Penpad and its basic driver program is that you'll probably need to practice making some letters and characters until the pad can recognize them routinely.

Pencept has also created applications software for Penpad. The most interesting of the Penpad applications is Videogram ($300), the art program used by both Nat Mody and Alan Zenrich. It requires a high-resolution color adapter board for the computer. Videogram offers 16 colors and a resolution of 320 by 200 pixels. The Videogram template uses colored icons, most of which produce on-screen menus like those of MacPaint, the graphics program for Apple's Macintosh. The program includes automatic geometric shapes, multiple brush shapes and sizes, and lets you magnify the screen for detailed editing. Output can be sent to a printer or to the Polaroid Palette, a device which makes slides and prints of computer screen images. Also, Videogram can "pick up" screen images created by other programs, so you could use it to enhance a graph created with Lotus 1-2-3.

Videogram has an excellent selection of text fonts and sizes. In addition, after you've chosen the text for your picture, you can move the lettering, change its color, even stretch or compress the text into different sizes. Although its pros outnumber its cons, Videogram does lack a number of features available in other art software for the IBM. It doesn't let you create color mixtures, and lacks easy-to-use "spray" and "eraser" modes. A computer art tool with Penpad's potential deserves an improved software product soon.

Another Penpad art program, Pendraw, is included in the purchase price of the pad. It works in four colors with the standard IBM graphics adapter. It lacks some of Videogram's features, but offers many more printer options.

Less showy but more efficient is Penform, a program bundled with the system that allows you to use Penpad as a data-entry tool. With the forms you currently use in your business as models, you can design forms on Penpad graph paper that can be photocopied and used with Penform. Although Penform includes some simple search options, it is really intended for use with programs such as dBASE II and 1-2-3 (a software interface for 1-2-3 is included). Data entered with Penform can be saved in ASCII format or as DIF (data interchange format) files.

The remaining programs, optional interface software called Penpacks ($50 each), which are intended to let you use Penpad to command Wordstar, Multiplan, and IBM Personal Editor, are less useful. Wordstar, for example, has so many commands that they can't all be listed on the standard-size template. It takes longer to remember which commands are on the pad and which aren't than to call up a help screen and enter the command on the keyboard. The interfaces also let you use the pen for cursor control, but the pen button must be pressed the entire time.

Mightier Than the Key?

In graphics production, Penpad really shines, allowing artists or designers to work with a single input device for graphics and text.

For text entry, Penpad's strong appeal is to nontypists; it's difficult for a journalist who makes a living at a keyboard to see the benefit in returning to laborious hand printing for lengthy text entry. But Blue Cross and Blue Shield of South Carolina's testimony is convincing. As a limited data-entry device to be used by nontypists, the Penpad is a viable alternative to traditional computer terminals.

—TAN A. SUMMERS

Tan A. Summers, who lives in New Orleans, writes frequently for *Popular Computing*.

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ized enhancement of a scene that can then be superimposed on the original photograph.

Applications Software

The basic Penpad driver program works well with most applications software. In this mode, the computer treats characters you write on the pad exactly as if they were entered on the keyboard. In fact, the only drawback to using Penpad and its basic driver program is that you'll probably need to practice making some letters and characters until the pad can recognize them routinely.

Pencept has also created applications software for Penpad. The most interesting of the Penpad applications is Videogram ($300), the art program used by both Nat Mody and Alan Zenrich. It requires a high-resolution color adapter board for the computer. Videogram offers 16 colors and a resolution of 320 by 200 pixels. The Videogram template uses colored icons, most of which produce on-screen menus like those of MacPaint, the graphics program

price of the pad. It works in four colors with the standard IBM graphics adapter. It lacks some of Videogram's features, but offers many more printer options.

Less showy but more efficient is Penform, a program bundled with the system that allows you to use Penpad as a data-entry tool. With the forms you currently use in your business as models, you can design forms on Penpad graph paper that can be photocopied and used with Penform. Although Penform includes some simple search options, it is really intended for use with programs such as dBASE II and 1-2-3 (a software interface for 1-2-3 is included). Data entered with Penform can be saved in ASCII format or as DIF (data interchange format) files.

The remaining programs, optional interface software called Penpacks ($50 each), which are intended to let you use Penpad to command Wordstar, Multiplan, and IBM Personal Editor, are less useful. Wordstar, for example, has so many commands that they can't all be listed on the

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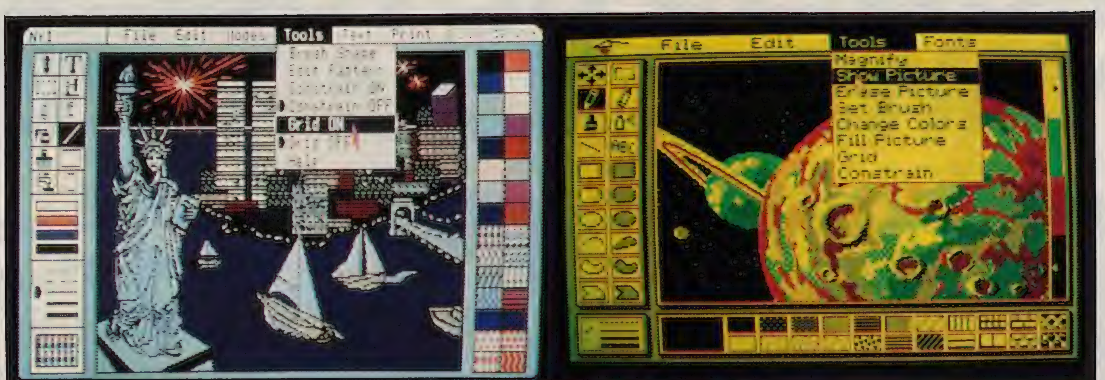

ICONS AND PULL-DOWN MENUS HELP COMPUTER ARTISTS PAINT AND DRAW ON-SCREEN. COLORPAINT (TOP LEFT), PC PAINT (ABOVE), AND PC PAINTBRUSH HAVE DIFFERENT STRENGTHS AND WEAKNESSES BUT ALL PROVIDE HOURS OF CREATIVE FUN.

ColorPaint, PC Paint, and PC Paintbrush

Mac-like art programs for the IBM PC and PCjr color your screen

The Apple Macintosh, with its superb MacPaint program, was bound to inspire imitators. MacPaint did just about everything an artist could possibly ask and was still easy to use. A mouse eliminated the struggle of painting with a joystick or keyboard. There were no commands to remember. Instead, little pictures of a spray can and an eraser controlled options logically named spray paint and eraser.

Pull-down menus offered depth. You could magnify part of your picture and change it one pixel at a time, create instant mirror images, and add text in exotic typefaces.

"MacArt" was more than good, it was fun. And, sure enough, a year later, MacPaint imitators are moving in. It's a testament to MacPaint's excellence (and how difficult it is to program the Macintosh) that no one has seriously challenged MacPaint on its own turf. The best of the copies run on computers like the IBM PC and PCjr and add color, the one dimension MacPaint doesn't provide.

Here I examine three MacPaint look-alikes: ColorPaint, PC Paintbrush, and PC Paint. All three have Macintosh-like screens with rows of icons to indicate options. At the top of the screen are pull-down menus that work like the Macintosh's—you place the cursor on a menu title and move it through the choices. The

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highlighted selection is activated when you release the mouse button.

The most obvious differences between these programs and MacPaint are color and screen resolution. The Mac displays only black and white but provides a dazzling resolution of 512 by 400 pixels. The PCjr offers 16 colors and many shades but the resolution is only 320 by 200 pixels. This limits picture detail.

Other differences are less obvious. Both the IBM PC and PCjr take more time to change the screen than the Macintosh. Also, neither ColorPaint nor PC Paintbrush has as many functions and shortcuts as MacPaint. Missing are trace lines and symmetrical mirroring, although PC Paint allows double-click commands for calling submenus.

The three PC programs differ from each other, too. The ColorPaint and PC Paint screens are more attractive than PC Paintbrush's, with finer lettering and cleaner lines. And ColorPaint offers more tasteful color combinations.

On the other hand, ColorPaint is less flexible. It runs on the PCjr only, whereas the other two run on the IBM PC as well. On the PC, Paintbrush supports a multitude of graphics boards and modes. PC Paintbrush pictures take up much less disk space than ColorPaint's. PC Paintbrush also offers more printer options and includes a slide-show program for viewing images on-screen.

ColorPaint

ColorPaint, created for the PCjr, comes on a cartridge and doesn't require extra memory or even a disk drive. The program automatically responds to most two-button serial mice with no extra setup. The package lists the Microsoft and Mouse Systems mice as compatible. (If your mouse isn't listed, it still should work with ColorPaint if you load the mouse's driver software before starting the graphics program.)

Documentation includes a 38-page step-by-step learning guide for people unfamiliar with mice, art programs, and the icon/pull-down-menu environment. There's also a more detailed, 56-page reference booklet. Both are attractive and easy to understand.

ColorPaint's screen has 12 icons, compared to MacPaint's 20. The Mac's extra icons are mainly automatically filled-in shapes and irregular closed figures. ColorPaint uses menu commands to designate automatic filling of circles, ovals, rectangles, and squares.

AT A GLANCE

ColorPaint

Manufacturer
IBM Corp.
POB 1328-S
Boca Raton, FL 33432
(800) 426-3333

Price and Hardware Requirements
$99; IBM PCjr; requires serial mouse

Audience
Anyone who is interested in creating computer art for pleasure

Reviewer's Note
This program is great fun to use but its printing capabilities are limited

Solid shapes can be colored in a second step with the fill commands. You can fill solid areas as many times as you please, but patterned areas are permanent. The straight-line icon doubles for the Mac's connected-line function; you produce connected lines, boxes, or concentric circles with ColorPaint by holding down one mouse button continuously while clicking the other to mark the location of new lines or circles.

ColorPaint lets you move or copy square areas of a picture with the window icon, but lacks MacPaint's lasso, which lets you "rope" and manipulate odd-shaped areas. The microscope icon enlarges a picture section for pixel-by-pixel editing.

The freehand drawing and painting modes are represented by pencil, paintbrush, and spray icons. Paintbrush provides 15 brush shapes on its tools pull-down menu. One button on the mouse activates these commands, and if you don't like what you've created, the other button lets you retrace your steps and unpaint or spray. Paintbrush and spray use whatever pattern you select. Lines, however, can be drawn in only one of four colors and three line widths. Two types of dotted lines allow more subtle drawing. There's also an eraser mode.

Spectacular use of color is ColorPaint's best feature. Although only four colors can be selected for drawing at any one time, they can be any of the 16 PCjr colors. The 30 color and pattern mixtures along the right side of the screen are combinations of those four colors and change with the four you select. You can try 3000 possible combinations to get different colors. When a picture is saved, it remembers which palette you used.

Scroll and text functions complete the icon repertoire. Scroll lets you move the picture around the screen. For text, you select one of four fonts in three sizes. Bold, underline, and italic are additional options. An invisible grid helps you align for accurate spacing.

The tools menu also lets you call a help screen and create your own patterns with up to four colors. Editing patterns is fun—as you work, you can see how each change to the sample block will affect the overall design.

The modes menu includes commands to move parts of a picture. Move or copy determines what happens to a screen section marked with the window icon. You can also make the block's background transparent or opaque. Transparent works only with white backgrounds, however. Colored backgrounds always move with a block.

The edit menu's undo command lets you fix mistakes. Invert lets you reverse the colors within a selected area, creating dazzling effects. Flip vertically and horizontally turn your picture sideways and upside down. The merge function combines an image from another painting with your current work.

The file handling and print menus are more prosaic. File consists of get, save, delete, and quit. When you get or save a file, ColorPaint prompts you with available filenames, then makes you double-check to be sure you haven't made a mistake. The print menu lets you choose

the IBM Compact, Graphics, or Color printer. Other printers also will work, if their driver software can command ColorPaint.

PC Paintbrush

PC Paintbrush comes on a disk and requires 256K bytes of memory. It won't run on the 128K-byte PCjrs. However, it uses only 192K bytes on the IBM PC, works with joystick, graphics tablet, or mouse, and is compatible with most graphics adapter boards. IMSI, the manufacturer of PC Paintbrush, offers over 30 possible configurations, including a 16-color setup with a resolution of 640 by 400 pixels for Tecmar's IBM PC Graphics Master adapter board.

All of this versatility makes PC Paintbrush more difficult to set up initially, especially for those PCjr owners who must work out the correct configuration for their memory expansion unit. However, PC Paintbrush's installation program automatically creates the start-up files. Once installed, it loads without prompting from the keyboard.

Overall, PC Paintbrush is quite similar to ColorPaint, although some commands work differently. The paintbrush icon does double duty, drawing and painting in any of 32 colors and textures with 10 brush shapes and sizes. PC Paintbrush fills faster than ColorPaint, but its spray is less uniform and produces a harsher effect. Filled and hollow boxes and circles are selected from an icon menu like MacPaint's and are drawn in the desired brush width and color. An extra eraser mode selectively erases only the current drawing color. A small hand scrolls the screen, which has a picture area smaller than MacPaint's or ColorPaint's.

The text icon lets you write on the screen with any of 11 fonts, ranging from ancient Greek and Old English to computer, in 9 sizes. Further options include italic, outline, and bold.

The window icon differs from MacPaint's. Instead of clipping a segment for editing, the window creates new patterns from sections of the screen. PC Paintbrush also lets you create mixtures with any number of colors using the edit patterns commands, and you can adjust the palette using menu commands. You can save a palette and recall it later.

AT A GLANCE

PC Paintbrush

Manufacturer
IMSI
Suite PHB, 1299 Fourth St.
San Rafael, CA 94901
(415) 454-7101

Price and Hardware Requirements
$139; IBM PC, XT, AT, PCjr, and compatibles; requires 192K bytes of memory (256K bytes on PCjr); joystick, serial mouse, or graphics tablet; works with wide variety of graphics adapter boards

Audience
Serious computer artists

Reviewer's Note
A little more complex than ColorPaint, PC Paintbrush puts more power at your fingertips

PC Paintbrush offers ample editing power. When you clip a picture area with the scissors icon, it's automatically saved on disk. It can then be copied or moved. Later, with the paste mode, you can recall the image for use in a new picture.

The brush mode lets you use a saved image as a painting cursor. Pressing the right mouse button while moving the cursor creates a continuous stream of ships, butterflies, or whatever. Pressing both buttons does the same in reversed colors. You also can shrink, enlarge, and tilt an on-screen image. And finally, the menu contains two magnification levels: fatbits and FATbits.

PC Paintbrush has a bad habit. It automatically assumes you want continuous lines or concentric circles, starting with the last point drawn on the screen. This is disconcerting but easy to override.

A definite plus for PC Paintbrush is its printer utility, Frieze, which can combine and print two pictures or parts of pictures. Frieze supports 13 plotters and printers, black-and-white as well as color. It lets you determine the margins and size of the printed picture, enlarging or shrinking from 1 to 24 inches per side.

Frieze will also double the print resolution, print a portion of a picture, merge two previously saved pictures, including those created by programs like 1-2-3, and print a picture sideways. An additional utility program called Setcolor helps you undertake detailed color mapping for advanced graphics applications. PC Paintbrush documentation, a thorough 69-page reference guide, explains all this very well, but it is complex territory for beginners.

AT A GLANCE

PC Paint

Manufacturer
Mouse Systems
2336H Walsh Ave.
Santa Clara, CA 95051
(408) 988-0211

Price and Hardware Requirements
$99; ($220 with Mouse Systems Mouse; Mouse alone is $195); IBM PC, XT, AT, PCjr, and compatibles; requires 256K bytes of memory and serial mouse

Audience
Anyone interested in computer art

Reviewer's Note
PC Paint is an excellent program and a delight to use

PC Paint

PC Paint is the most Macintosh-like of the three programs reviewed here. You can double-click the mouse button on several icons to access submenus and scroll through the list of pictures on disk by clicking the mouse on the up and down scroll arrows on-screen. You can save pictures with their current titles or with new titles. The program helps you avoid losing files by warning you if you're about to load or save a picture over a previous creation.

PC Paint's icons look like MacPaint's and include automatically filled shapes such as a square with rounded corners and freeform options for filling irregular shapes. Portions of pictures that you want to move, copy, or otherwise manipulate are stored in a clipboard just like the Mac's. PC Paint, however, doesn't have a lasso feature for manipulating irregularly shaped areas; saved screen sections must be square.

PC Paint runs on the IBM PC, XT, AT, PCjr, and compatibles and sup-

ports four printers. It requires 256K bytes of user memory, and two disk drives are recommended. You can store a limited number of pictures on the program disk. One welcome feature is PC Paint's "path" box, which lets you store pictures in various subdirectories on a hard disk.

Color is PC Paint's weak point. The paint palette allows you to change the background color and gives you some control over the three drawing colors. Owners of the STB Graphics Plus II card can produce 16 colors on-screen at the same time, however.

Nevertheless, PC Paint makes up in thoughtfulness for what it lacks in color. In addition to the double-click shortcuts, there's a quick way to move or copy portions of a picture without accessing one of the pull-down menus. When in magnify mode, the program gives you the choice of changing the color of pixels one by one or drawing freehand with the pencil. For graphs or other screens that call for precision detail, PC Paint provides constrain and grid modes that ensure accurate placement of lines. Colors can be inverted, and images can be rotated 90 degrees at a time or flipped horizontally or vertically. You can choose from 32 brush sizes and shapes and five text fonts.

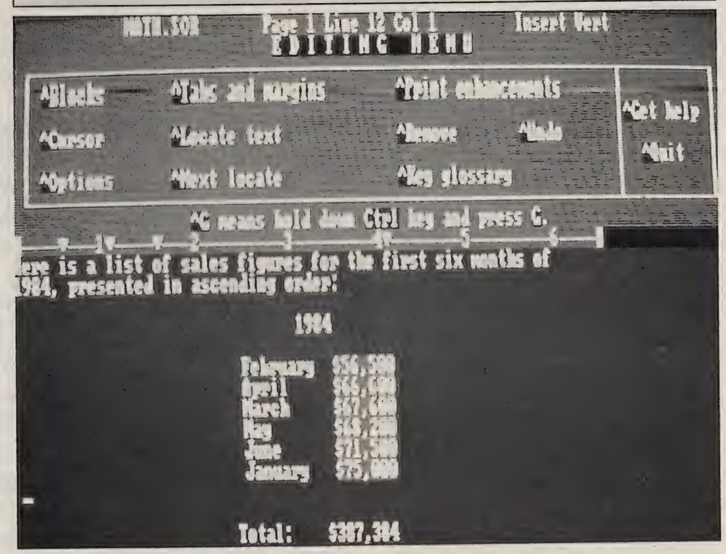
PC Paint works with any mouse but is copy-protected. The version sold with Mouse Systems' mouse, however, is not copy-protected but will work only with that mouse. Easy to use and well planned, PC Paint is a good choice if you're interested in computer art as recreation. It's the smoothest PC-compatible imitation of MacPaint I've seen.

ColorPaint's "holiday feel" is in the true MacPaint tradition. It shines in ease of use and palette selection and maximizes the PCjr's impressive graphics capabilities. PC Paintbrush has better capabilities for retrieving and using art. Its programming depth makes it a joy to explore, and that, too, is part of the MacPaint spirit. PC Paint fits solidly in the middle, offering IBM PC users a touch of ColorPaint's flash but without the technical heaviness of PC Paintbrush.

Hardware will dictate the choice among these three excellent programs for many of us. The serious artist with a 16-color high-resolution IBM PC should probably choose PC Paintbrush. Amateur artists with standard IBM graphics adapters will be well served by PC Paint and, of course, those using unenhanced PCjrs will need to use ColorPaint. But what about the owners of enhanced PCjrs, which can run all three? If you want an easy-to-use art program for sheer creative pleasure and have simple printing needs, either ColorPaint or PC Paint is the answer. If you need considerable printing versatility and like to tinker with your software, try PC Paintbrush. —TAN A. SUMMERS

Tan A. Summers is a freelance programmer and writer living in New Orleans, Louisiana.

WORD PROCESSING



Wordstar 2000

Micropro's full-featured word processor is aimed at business scribes

What is now somewhat of a legend in the microcomputer software world began without much fanfare at the West Coast Computer Faire in June 1979 when a fledgling company optimistically named Micropro International Corp. introduced Wordstar.

Originally developed for 8-bit CP/M computers, this word processor from the pioneer days of personal computing has been praised, explained, and damned in the greatest detail. Its complexity and popularity have generated income for teachers, writers, and software and book publishers who've all rushed in to explain and bolster the popular program.

Just how popular is this legend? Very popular, if numbers alone speak. Within five years Micropro shipped more than 1.25 million copies of Wordstar. In addition, the company claims, another 1 million illegally copied programs are being used, giving Micropro a potential customer base 2 million strong.

When Wordstar was first developed, it had little competition. But by 1984 the market was definitely getting crowded. Microsoft Word

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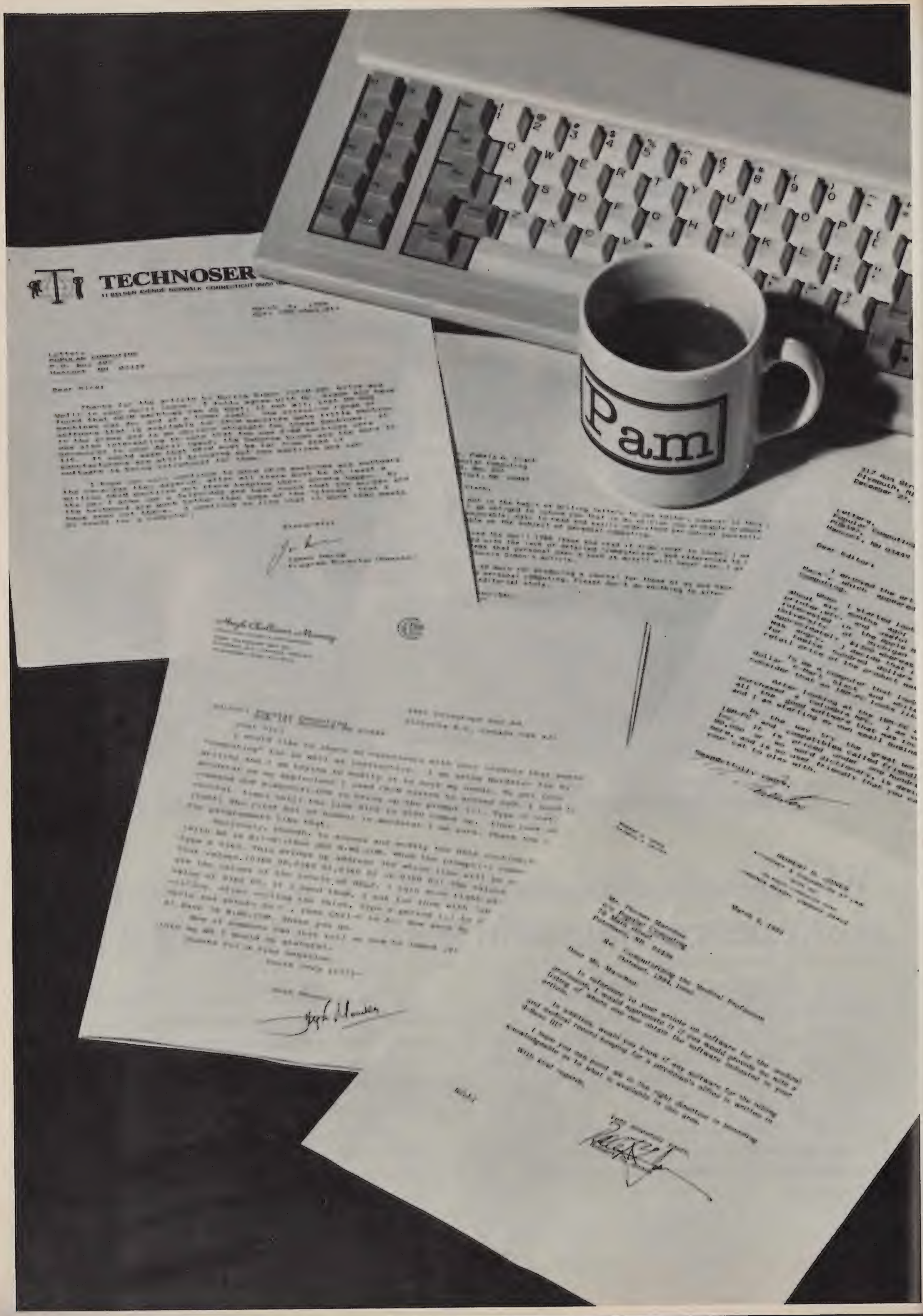
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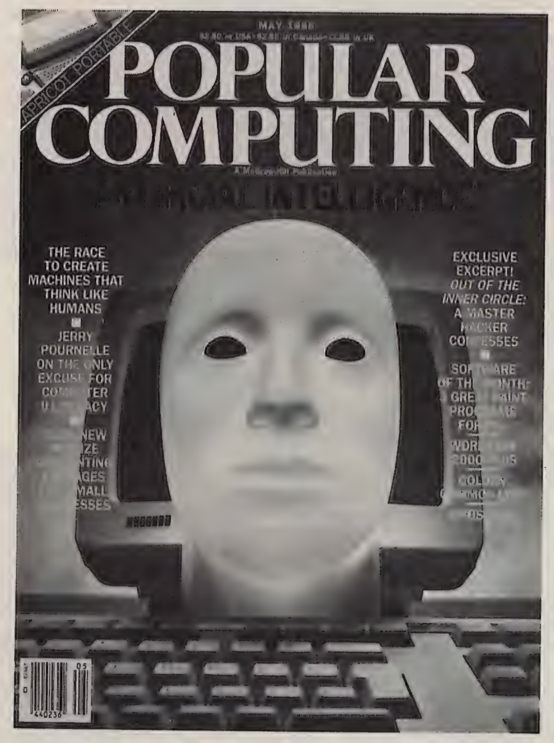

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A/MS15-36

and Samna Word III had additional features, and Multimate imitated dedicated word processors. To even its most loyal fans, the old workhorse was beginning to seem just a little behind the times.

The second stage of the Wordstar saga began on Halloween 1984 when Micropro unveiled Wordstar 2000, a business-oriented package with Mail Merge and Correctstar built in, and Wordstar 2000 Plus, which adds Telmerge for communications, Starindex for indexing, and Mail List, a name and address data-entry and storage form. (Throughout this review Wordstar 2000 refers to that program and the Plus version. I reviewed Plus.)

Although many people might logically assume that Wordstar 2000 and 2000 Plus are upgrades to Wordstar, that, according to Judi McClean at Micropro, is not the case. Wordstar will continue to be sold and upgraded (although McClean declined to give specifics) and is, she said, for "technically oriented people who are intrigued by exploring the capabilities of the software itself."

Micropro, McClean said, has designed Wordstar 2000 (which is not copy-protected) for new users in the corporate environment where it's competing with programs such as Samna Word III, Multimate, and Microsoft Word. Wordstar 2000's user interface combined with some of the best documentation I've seen—plenty of clearly organized training guides, reference books, and command cards; useful on-screen tutorials; and copious help messages—makes it easy to learn. And windows, automatic paragraph reformatting, an undo feature, arithmetic and sorting functions, and an integrated spelling checker all give Wordstar 2000 a firm place in the business market.

But comparisons with 2000's namesake are too hard to ignore and the similarities between the two programs are too great to convince me that Micropro did not have the new program in mind for Wordstar users tempted to switch to a later generation of word processor. Micropro has played it safe with its solid base of users. To answer some of the obvious questions nagging Wordstar users, I will at times compare the new program to the old.

Indeed, current Wordstar users will find that most of their wish-list items have been written into 2000 and that nearly everything they liked about the original Wordstar has been reupholstered, repainted, and squeezed into this chrome-plated program. Nearly everything, that is, except file compatibility with Wordstar and speed.

Micropro has replaced, added to, and improved many of Wordstar's mysterious print-formatting and page-design commands and rendered the two products incompatible. You must convert Wordstar files to Wordstar 2000's format and vice versa. And although the process is a snap using a utility provided, it means that it's unlikely the add-on products from third-party developers will work directly with 2000 files. (Micropro is currently working on a technical reference manual for the bit twiddlers who want to create add-on products or convert those written for Wordstar.)

And Wordstar 2000 is significantly, in fact agonizingly, slower than Wordstar on a floppy-disk system. But on a hard-disk system it compares favorably to its competition (see sidebar on page 110).

AT A GLANCE

Wordstar 2000

Manufacturer
Micropro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

Price and Hardware Requirements
2000, $495; 2000 Plus, $595. IBM PC, XT, AT, Compaq, Compaq Plus, and fully compatibles; requires 256K bytes of user memory and DOS 2.0 or higher; DOS 3.0 requires 320K bytes of memory

Audience
People who need a powerful business-oriented word processor

Reviewer's Note
Wordstar 2000 is a good bet for those with hard-disk systems and business applications

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You typically begin and end each session at the Opening Menu, from which you can open a new or existing document or type directly to the printer. You can print, check the spelling of, remove, copy, or rename documents on file. You can convert Wordstar files to 2000 files, create key glossaries (little files of text and commands to be inserted within documents), design page formats, and access the Mail Merge function. Additionally, those with 2000 Plus can choose Mail List and Starindex.

Context-sensitive help is available by typing G. Pressing Q will get you out of the program. Each time you quit and save changes to a file, Wordstar 2000 makes a backup of the previous version of each file.

You begin a writing session by naming a document and attaching a page format to it. Forms for memos, double-spaced manuscripts, unformatted data listings (Wordstar's nondocument mode), justified text, and ragged right margin come with the program. You can also easily create custom formats.

A document's format governs how one of the 102 printers supported by 2000—including the new laser printers—prints it. Although you can't see many of the parameters, such as justification, print fonts, and double-spacing on-screen, you can change most via control commands that set "command tags."

How Fast Is It Really?

Perhaps the biggest complaint about Wordstar 2000 is that it's too slow. It is slower than Wordstar on a floppy-disk system, but 2000 isn't competing against Wordstar.

To see just how slow or fast Wordstar 2000 actually is, I compared it against its competition—Wordstar v 3.31, Microsoft Word v 2.0, Multimate v 3.20, and Samna Word III v 2.0. I tried all these programs using the same 1800-word file containing typical text on a Televideo Color PC with a hard disk and 640K bytes of user memory.

Multimate and Samna saved a document in 3 seconds or fewer—very fast. Wordstar took 8 seconds, Wordstar 2000 took 17 seconds, and Word brought up the rear in about 23 seconds. But Multimate and Samna are page-oriented, so it took longer moving from one page of the document to another. Additionally, I could start Wordstar or Multimate much faster than any of the other programs.

Microsoft Word and Samna moved from the beginning to the end of a file, nearly instantly, and Wordstar was quite fast (about 2.5 seconds the first time and 1.3 seconds for moves thereafter). In contrast, there was a noticeable wait for Wordstar 2000 (about 30 seconds the first time and 8 seconds on subsequent moves). With Multimate, you had to move a page at a time, a process that took about 20 seconds the first time and 12 seconds on repeated moves. The more difficult task of converting an ASCII text file into a word-processing format exercises the programs' search-and-replace functions. Generally, this involves loading the file, marking the beginnings of paragraphs, removing carriage returns at the end of each line, then inserting carriage returns at the end of each paragraph. In this area, 2000 really shines. With Wordstar, the process took over 22 minutes. In contrast, Word followed the same process in under 2 minutes, Wordstar 2000 took about 3 minutes, and Multimate took about 6 minutes. If you mark paragraphs by two carriage returns, Samna can actually do the conversion without the search and replace function in two minutes. (In practice, however, I had to manually reinsert the paragraph indents, which took about 11 minutes.)

Though the latest version of Word is faster than Wordstar 2000 at editing documents, it is slower in moving through a document page by page. Because it is page-oriented, Multimate was fast while editing a single page, but very slow moving between pages. And Samna was generally quite fast, unless you tried reformatting, when the system nearly ground to a halt.

Wordstar 2000 ended up in the middle of the pack. For most word-processing functions, its speed should be adequate, though unspectacular.

—Michael J. Miller

Writing and Editing

Selecting a document takes you straight to the heart of the program with the Editing Menu. A status line at the top of the screen displays file name, cursor position by page, line and column number, whether you're using typeover or insert text mode, and new to 2000, whether you're working with vertical or horizontal blocks of text.

The Editing Menu lists mnemonic commands for 12 functions, half of which lead to further menus of control commands. You can reach all functions and features by using commands listed on these menus, which occupy the top third of the screen, and you can toggle the menus on or off.

Once you advance beyond the Opening Menu, the program relies on using the Control key in combination with one or more other keys to issue commands. Thirty-eight of the control commands, including the four-keystroke commands for spelling-checking and mail-merging functions, are duplicated on preprogrammed keys.

Even so, remembering which command to use when would have been overwhelming, were it not for memory-jogging aids such as the plastic quick-reference thingamabob that fits at the top of the keyboard and illustrates the preprogrammed keys. Also contributing to Wordstar 2000's ease of use are its clear design, thoughtful selection and organization of commands, and a series of full-screen help messages that give clear explanations of each command.

However, you needn't wade through any or all of 2000's myriad features and options. Those intent on the most basic typing tasks will find that it's easy to begin using the program with a minimum of fuss and learning. In fact, the documentation gives you the basics and guarantees results within 15 minutes after starting up the program. It works.

Although Wordstar's famous or

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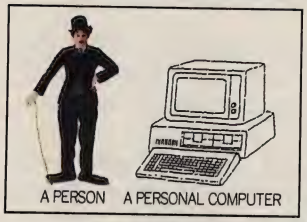

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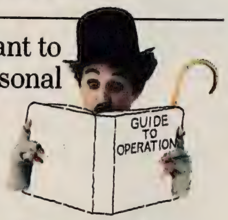

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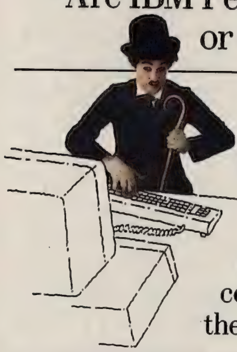

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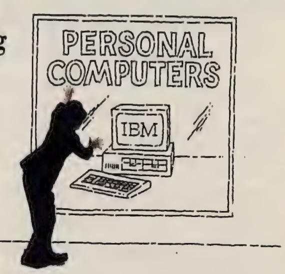

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perhaps infamous cursor-control diamond (Control S moves the cursor one character left, Control D one character right, Control E one line up, Control X one line down) is intact, the arrow keys, PgUp and PgDn, home, end, insert, delete, and (deleting) backspace keys also work and most can be combined with the Control key to extend their functions.

The undo command restores the last bit of text you deleted with either the remove or block commands and is particularly good for quick cut and pastes of sentences and paragraphs—or even block moves between windows.

Wordstar 2000 lets you split the screen into two or three horizontal windows. With two windows, the screen splits in half, with three, in thirds. Although you can't change the size of the windows, you can display different documents in each window or different portions of the same document. And all editing commands are available for use in each window. All in all, it's a fairly primitive use of windows.

Blocks and Options

Many of 2000's features are behind the Blocks and Options selections on the Editing Menu. The block commands include block arithmetic, which lets you add, subtract, multiply, and divide up to 13 digits in a vertical column or horizontal line, and block sort, which puts lines in vertical blocks into ascending or descending order. Vertical (columnar) or horizontal text blocks can be moved and copied within the document or between windows, removed, inserted in a file, or written to a file.

Behind the 18 option commands lie additional menus for the 11 Mail Merge commands, 4 spelling-checking options, and 9 indexing options.

Correctstar has a 65,000-word main dictionary, 9000-word internal dictionary, and allows you to add 1500 words. Wordstar 2000 suggests alternate words when it can find one that "sounds" like the misspelled word, and it's reasonably intelligent with its choices. You can check one word, a paragraph, or the rest of the

document, accepting suggestions, ignoring the find, or creating a personal dictionary as you go along.

Mail Merge includes commands for inserting text, data, or operator input into a document at print time; creating "personalized" form letters; and joining an unlimited number of files at print time so that pages are consecutively numbered and for conditional printing.

Easy-to-use sample templates of commands are included with the program; this is helpful because writing your own command sequences isn't so easy. Although the documentation is quite good, once you begin flexing the program's muscles—using complex conditional statements and nesting up to four files—you are in fact writing little programs. One little program I wrote took me a few hours to debug.

In addition to calling up entire programs, option commands include many of Wordstar's former dot commands for page-design functions, such as assigning page numbers, centering text, defining headers and footers (now multiple lines), and three flashy new options, which are windows, footnotes, and repeat (a string of any characters or commands you type in).

More Options

Additional menu commands control setting tabs and margins locating and automatically replacing text, creating key glossaries, and controlling the way a document looks when it's printed. Print enhancements can be part of initial format design or selected later to override the default format. Selected commands appear on-screen in square brackets when you choose to display them. They include the typical boldfacing, underlining, overstriking, and subscripts and atypical print pausing, print fonts, line spacing, and color choice.

With a key glossary, a kind of macro, you assign a short code to text or commands and store same in a key file. When you type the short code and press Escape, the text is entered automatically or commands executed automatically.

A key file can hold 20 key glossaries as long as the total number of characters is fewer than 2000. Key glossaries are useful for frequently used multiple commands like those used for checking spelling, mail merging, and repeated phrases like letter closings and salutations.

Mail List, Starindex, Telmerge

Wordstar 2000 Plus's Mail List program provides a nonmodifiable data-entry form for names, addresses, phone numbers, and short comments. It stores the data in the comma-delimited files required for Mail Merge. In addition, you get sample forms of commands for label printing and customized letters. Mail List looks and acts remarkably like Micropro's Datastar. While it is limited, its compatibility with Mail Merge makes it a convenient method of name and address storage.

Starindex lets you mark items to be indexed and create tables of contents, figure captions, and cross-references, all while you're writing.

The easy-to-configure Telmerge lets you send Wordstar 2000 files from one personal computer to another, use electronic mail and conferencing programs, and sign onto networking programs. Phone numbers and sign-on codes can be stored in files and automatically carried out when you enter an identifying code.

I have a couple of complaints about Telmerge, however. Files can be downloaded into a default file name only. When you use Telmerge with The Source, the downloaded file goes into a file named Source.log. If one exists, data moves into Source.sav; if both exist, into Source.bak. This requires extra work in renaming files. Also, files telecommunicated into 2000 automatically get the unformatted (nondocument) format and land with carriage returns at the end of each line. Although you can remove them with locate and replace commands, it's a hassle.

You cannot rename or move files from within a document. And although the program makes it easy to remove files when a disk is full, so that you can save changes to the document you're working on, it leaves you with no other choice. You can't place them on another disk. You might find yourself faced with deciding which batch of work you never want to see again.

The automatic reformatting is pretty smart, but there are times when I had to trick the program into reformatting a paragraph by deleting a word, then undoing it.

The first time you scan a file, the program takes a long time to get to the end because it checks all the automatic reformatting and format commands as it goes. Subsequent scannings move quickly because the checking process is a one-time thing.

Who's This For?

Micropro says that Wordstar 2000 is designed for the high end of the marketplace and that people with machines in the low end (CP/M, IBM PC, and PCjr) may still want the original Wordstar. Few people with dual disk-drive systems will put up with 2000's sluggishness.

And, bear in mind, that although close to the original in design, and carrying the same name, Wordstar 2000 is not the same. It is not the 5-year-old well-used, well-worn, and well-tested standard. It is totally new, written from the ground up (in C), and as a result, contains the unavoidable kinks that remain to be ironed out. The flip side, however, is that this program is designed with a new generation of hardware, operating systems, and windowing environments in mind.

I have to admit that even after using Wordstar 2000 on a floppy-disk system, I've become rather used to it and addicted to some of the features such as undo, windows, and automatic reformatting. And its simplicity, plus the programmability and power, which are both reminiscent of Wordstar, make it an easy choice to recommend for those who've kept pace with the new generation of hardware. People with those new monster micros with fast chips and hard disks should strongly consider Micropro's new baby. □

—BARBARA ROBERTSON

Barbara Robertson is a Mill Valley, California-based journalist.

LANGUAGE

GCLISP

This version of AI's favorite language goes farther than others as a true LISP for micros

It's remarkable that LISP is still going strong considering that most of the other programming languages developed with it in the late '50s and early '60s are now obsolete or moribund. LISP has continued to grow and change and has attracted a large and devoted group of fans, especially among researchers in AI—artificial intelligence. (For an in-depth look at AI and expert systems, see this month's Special Report, starting on page 66.)

The reasons for LISP's success are many. Its facility with symbol manipulation (LISP stands for LISt Processing), its uniform representation of program code and data, and the ease with which it can be modified are certainly first among them. Another important reason is the recent development of LISP machines—extremely powerful and sophisticated software development "environments" (an integrated editor, compiler, interpreter and debugger) running on custom hardware designed expressly for executing LISP efficiently.

However, those state-of-the-art tools are expensive and tend to be used only by those interested in developing LISP programs. And the microcomputer versions of LISP generally have severe limitations for serious programming efforts. But a new program, while not the definitive answer, does show some promise.

Golden Common LISP (GCLISP) is billed as a subset of the de facto standard of the LISP language, Common LISP. But GCLISP differs in one technical aspect (the way it handles a feature of the language called scoping) from the manner in which Common LISP handles the same feature. Until this is rectified (Gold Hill, GCLISP's developer, has such plans), I wouldn't call this a true subset of Common LISP. But while the scoping issue is a big chink in its armor, GCLISP is at present the best microcomputer implementation of the language. As such, it certainly deserves attention.

GCLISP, which runs on the IBM PC (and compatibles) with at least 512K bytes of user memory, has an impressive number of features. Yet its extravagant use of memory makes any large applications impossible on an IBM PC. And the fact that it's interpreted (an interpreter translates and executes code line by line) rather than compiled (a compiler translates an entire program at once then executes it) makes it fairly slow.

Gold Hill says it will fix these problems too in later releases. As it is now, GCLISP is most useful for small programs, such as simple natural-language parsers, and educational purposes. GCLISP has all the power you'd need to write programs for a college course in LISP or AI.

GCLISP (which is copy-protected) contains a user's guide and reference manual, five disks, and two books—the *Common LISP Reference Manual* by Guy L. Steele Jr. (Digital Press, 1984) and *LISP* by Patrick Henry Winston and Berthold Klaus Paul Horn (Addison-Wesley, 1984, 2nd ed.). Two of the disks contain a LISP tutorial called the San Marco LISP Explorer, one contains some utilities, another the editor, and the fifth contains the GCLISP system.

The documentation is thorough. Since GCLISP is essentially Common LISP, the major reference is the *Common LISP Reference Manual*. Gold Hill supplies its own reference manual, which points out all the differences between Gold Hill's LISP and Common LISP. The editor manual is adequate and the LISP tutorial therein is sketchy, but the LISP textbook and San Marco LISP Explorer tutorial program make up for the manual's problems.

Golden Common LISP has all the standard LISP features you'd expect: integer and floating-point numbers, a host of list operations, functions, macros, and iterative and recursive control structures.

Some of its additional features include arrays, generalized variables, optional and rest function parameters (which provide the ability to pass optional arguments to a function and to define functions that take any number of arguments), closures, stack groups (which provide a basis for multitasking), multiple values (functions can return more than one result), packages (which provide sep-

arate name spaces for variables and functions), transcendental functions (which use and for the most part require the 8087 coprocessor), strings, structures (like Pascal records), formatted output, a window system, and direct access to the PC's memory and I/O ports.

A number of GCLISP's features simplify program development. These include the GMACS editor, debugging facilities such as tracing and stepping, and single-keystroke commands that do useful things like return to DOS or provide the argument list for the function you're currently typing.

GMACS, as the name suggests, is very much like the EMACS editor developed at MIT. It is a fairly sophisticated text editor with the ability to handle multiple buffers and windows and some special features for editing LISP programs. When you type a right parenthesis the corresponding left one blinks, making it easy to match parentheses, for example.

An automatic formatting feature helps you write good-looking code, and an "evaluate-form" command lets you evaluate a function in LISP while still in the editor. You can leave the editor and go back to the GCLISP interpreter with a few keystrokes, and when you reenter the editor things are just as you left them. Although the editor takes about a minute and a half to start up the first time, switching back and forth between the interpreter and the editor is quick.

Since the editor interfaces so well with the interpreter, it's easy to modify programs interactively: you just enter the editor, change the functions you want to, reevaluate only those functions—no need to load the whole file—then go back to the interpreter to rerun your program.

GMACS has only one serious problem: it uses a lot of memory. This limits the size of programs you can run and the size of files you can edit.

Limitations: Space and Speed

Although GCLISP will run with 512K bytes of user memory, you won't be able to write very big programs. And if you use GMACS (which greatly simplifies writing code) you'll have even less space left for program development. To do any real work—for example, a small expert system or natural-language interface—you'd need well upward of 512K bytes and probably the full megabyte supported by GCLISP. And even if your program just fits in memory, you may be annoyed as GCLISP spends time deleting unnecessary data to clear important memory space. These "garbage collections" can be particularly bothersome when you're typing in the editor. So large programs are out, and small- to medium-sized programs are possible but perhaps annoying.

AT A GLANCE

Golden Common LISP

Manufacturer
Gold Hill Computers
163 Harvard St.
Cambridge, MA 02139
(617) 492-2071

Price and Hardware Requirements
$495; IBM PC or compatible with 512K bytes of user memory

Audience
AI companies, LISP programmers, or those interested in learning LISP

Reviewer's Note
GCLISP is at present the best microcomputer implementation of the language

Another serious problem with GCLISP is speed. It's still faster than, for example, IBM BASIC—a Sieve of Eratosthenes program I wrote took 21 seconds in IBM BASIC, 15 seconds in IBM BASIC using integer variables, and only 10 seconds in GCLISP—but not nearly as fast as a compiled LISP would be.

To be useful, GCLISP will have to be compiled. A compiler would also ease the space crunch. (As of this writing Gold Hill is working on a compiler.)

But what of GCLISP's compatibility with Common LISP? A while back representatives of most of the major LISP dialects decided to pool into a single language the best ideas of the LISP systems of the past 20 years. They came up with Common LISP. The advantage of having a standard language is portability. If you have a Common LISP implementation, then you have, or will have shortly, the ability to transport your programs to any other implementation of Common LISP, which may well include every major implementation of LISP. This may be essential if you plan on sharing your programs with, or selling them to, a wide community or even if you have two different implementations of the language in-house.

GCLISP has some features that Common LISP doesn't, which is OK—Common LISP was designed to be a subset of LISP implementations—and it is also lacking some features of Common LISP, like multidimensional arrays. Additionally, there are minor inconsistencies between the two languages. These discrepancies are merely inconveniences and are most likely temporary. Gold Hill says that "GCLISP will evolve toward full implementation of the Common LISP standard."

But there is a very important compatibility issue. All major LISP dialects have traditionally been dynamically scoped. This means, roughly, that the run-time behavior of the program—which functions call which other functions—determines which identifiers are visible to the functions comprising the program. However, Common LISP, for very good reasons that I won't go into here, is lexically scoped. This means in essence that the run-time behavior has nothing to do with determining what identifiers are visible when. Most common compiled languages, like Pascal and C, also are lexically scoped. The two scoping disciplines are radically different, and GCLISP has the wrong one. It's dynamically scoped.

Speed of operation is the major reason GCLISP's designers chose to go against the grain. If the program were lexically scoped, it would be twice as slow as it is now, but it would be in line with Common LISP. Gold Hill designers plan to rectify the situation by making the program

lexically scoped, which will slow it down, but also by offering a compiler, which will speed things up. For now, the manual suggests that you not write code that depends on the distinction. That, however, requires extra work and careful thought.

Who Should Use GCLISP?

GCLISP is not suitable for large applications. If you want to write large LISP programs, you should be using a machine more powerful than the IBM PC. A more likely choice is the IBM PC AT, which GCLISP will soon be running on. Compiled LISP on a machine like that will be a serious development system. In the meantime, GCLISP is fine for small AI programs, like simple natural-language parsers and production systems. Be sure, though, that you're not underestimating the size of your project: AI programs tend to grow as they're developed. On the whole, while GCLISP is the best bet for AI on a microcomputer, it is still a risky bet in its current incarnation.

Where GCLISP is definitely not a risky bet is education. GCLISP is an excellent starting point for learning LISP. First of all, it's as close to Common LISP as you can get on a micro right now, so learning it will make it easier to pick up most other LISP dialects. Furthermore, it's not a toy; it's sophisticated enough for college-level work. Finally, GCLISP comes with some fine teaching material.

In addition to the *LISP* book, which is an excellent and widely used introductory text, the San Macro Lisp Explorer is a thorough and very clear tutorial program. The Explorer, a sort of animated on-line textbook, presents a few screenfuls of information, then tests you on your grasp of the material by asking you to solve some simple exercises. You can enter GCLISP at any time to review or practice and return to the Explorer when you're done.

The Explorer's most novel feature is the Inspector. It lets you watch a LISP computation unfold before your eyes, graphically displaying which functions call which other functions. It's an excellent way to learn about some of the finer points of LISP, particularly recursion, and you can also use the Inspector as a debugging tool for your own GCLISP programs. Furthermore, the Explorer is based on the *LISP* book and includes many of the programs in that book, so the two teaching aids work well together.

A Few Flaws and Many Virtues

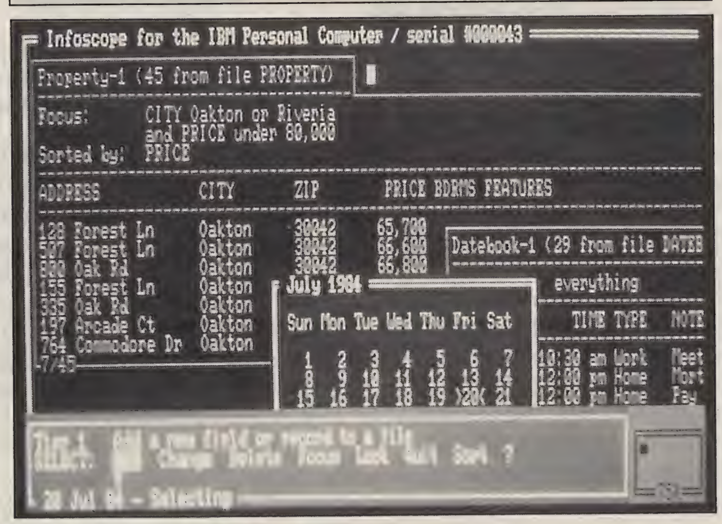
Despite its drawbacks, however, GCLISP remains a remarkable achievement. It's a very powerful programming language and development system, more sophisticated than any other microcomputer LISP I'm aware of, and it even surpasses some minicomputer implementations in terms of its features. In fact, as someone who has used $80,000 Symbolics LISP Machines, I am amazed at the number of features Gold Hill has squeezed into a microcomputer LISP; GCLISP has well over half the features of a LISP Machine.

Right now the memory and speed limitations are problems for serious work. But if you own an IBM PC or compatible and you want to learn LISP or experiment with artificial intelligence programming on a small scale, GCLISP is an excellent choice. Its designers have created what amounts to a first step toward producing a true LISP package for the micro.

—JONATHAN AMSTERDAM

Jonathan Amsterdam is pursuing a graduate degree in artificial intelligence at the Massachusetts Institute of Technology.

DATABASE



Infoscope

Fast sorting and data retrieval are just two of this program's many attractions.

Database programs aren't exactly a dime a dozen, but there sure are a lot of them out there. Among the many, Infoscope distinguishes itself by being an unintimidating, fast, and flexible mid-range database program that can be used efficiently and productively by almost anyone, including those unfamiliar with query languages. And it has enough extras to satisfy even the most demanding database architect.

Infoscope's ease of use makes it ideal for someone who wants a versatile database manager but doesn't

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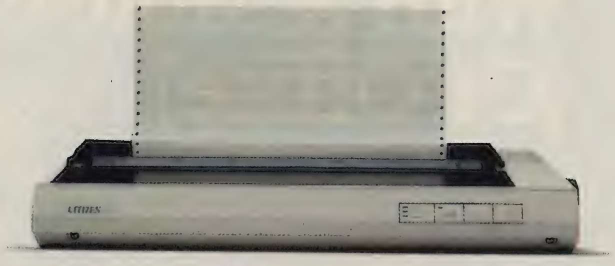

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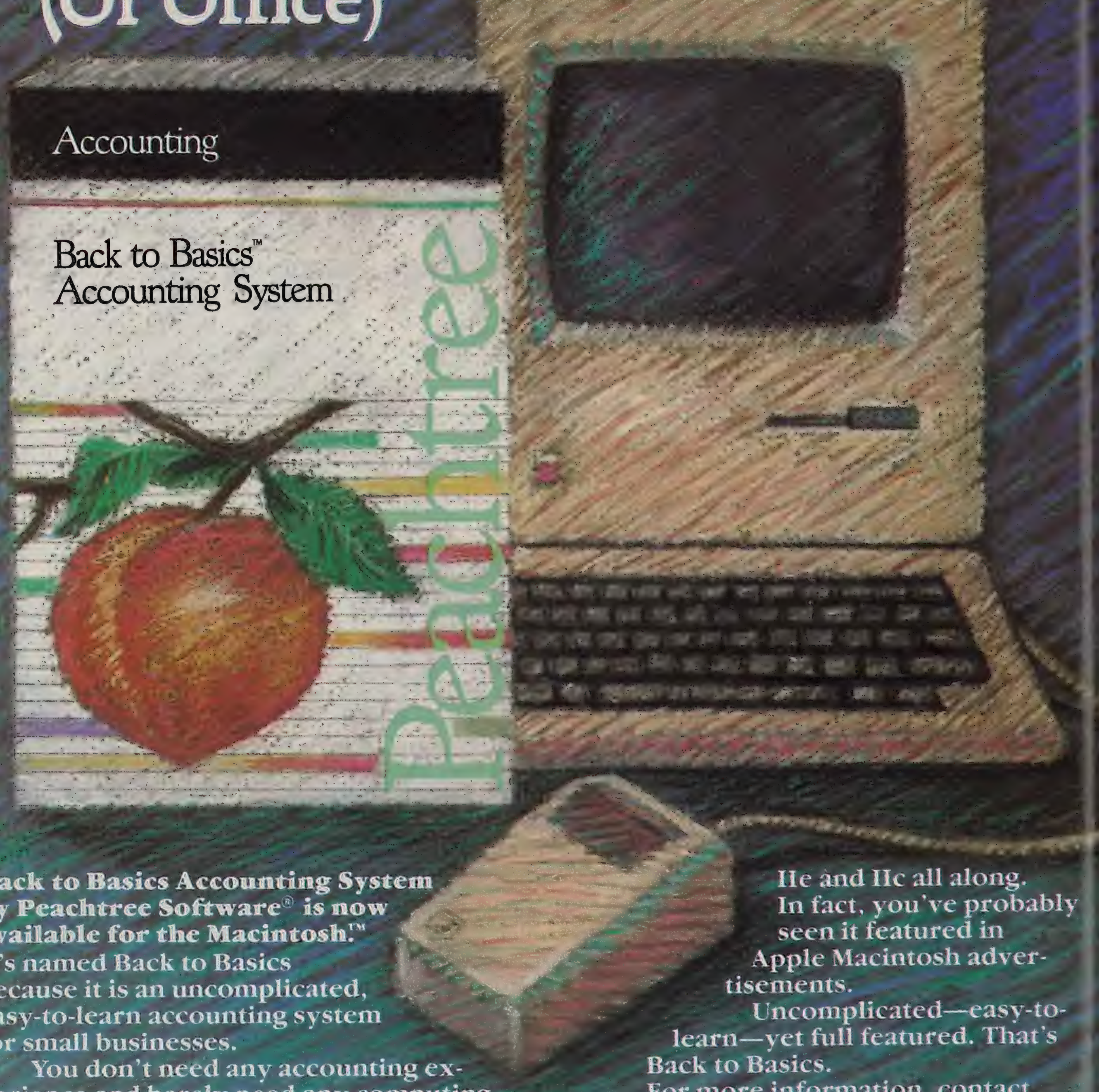

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want to spend a lot of time learning cryptic commands. A menu-driven program, Infoscope also lets you enter commands directly, in abbreviated format, or customize its macro language to perform tasks according to your needs.

Its speed makes it attractive to those whose database needs involve retrieving information based on varied and often changing criteria. Because Infoscope files reside entirely in RAM, record selections are so fast that if you blink, you may literally miss all the action. (The down side of this is that database size is limited by RAM.) Infoscope is particularly well suited for keeping personnel records, some types of inventories, client records, or as the supplied sample database suggests, real estate listings.

But while Infoscope has extensive sorting and data retrieval capabilities, it's weak when it comes to calculations. About all it can do is add and average fields. This, along with the absence of derived fields, makes it a poor choice for applications such as accounting, time billing, or inventories in which, for example, you need to calculate a mark-up price or your total investment in an inventory.

Infoscope's macro language, windowing feature, and built-in spelling checker make this program a true friend to those who design databases, especially databases that less-experienced computer users will have to maintain and operate.

Getting Started

Creating an Infoscope database is no mysterious affair. Following the on-screen prompts, you name fields and describe the type of data they will hold. Field types include alphanumeric, integer, money, date, time, stock (which permits you to enter stock market information), counter (for simple integers such as check or part numbers), switch, and category. Switch is used for simple yes/no information, and category is similar to alphanumeric data except that the items entered into a category field are added to Infoscope's internal vocabulary so subsequent entries can be checked for spelling.

RAM size imposes practical limitations on the size of the files you can create. With 256K bytes of RAM, you'll have only a 96K-byte work area after you load Infoscope. How useful this much space will be to you depends entirely on the data you store and the way you organize it. For example, 96K will hold a representative mailing list file of about 1200 records, assuming five fields and 80 characters per record. With more RAM, you can have bigger files. Although you can work only with what will fit in RAM at any one time, you can store your files on as many disks as needed.

AT A GLANCE

Infoscope

Manufacturer
Microstuf
Suite 140, 1000 Holcomb Woods Pkwy.
Roswell, GA 30076
(404) 998-3998

Price and Hardware Requirements
$225; IBM PC and compatibles

Audience
Individuals and small companies that need to access and manipulate database information quickly and easily.

Reviewer's Note
This program will be useful to new computer users and to organizations whose databases are not too large to fit into their computer's RAM

While Infoscope doesn't require you to indicate the size of your fields before you design the database, it does impose size restrictions. The program allows 250 fields per record, 256 characters per field to a maximum of 64,000 characters per record, and 8100 records per file. You can have eight files open at one time.

A tribute to Infoscope's flexibility is the fact that you can add or delete fields even after you have entered information in records. Not many programs give you this very crucial freedom.

A built-in form generator allows you to position data anywhere onscreen so that, for example, a form used to keep track of checks can look like a blank check. And Infoscope will accept and display time and dates in whatever form you like. Infoscope recognizes a.m. and p.m., so you don't have to use military format (24-hour) notation. Similarly, money information can be displayed with or without a dollar sign. Additionally, you can move or "hide" selected fields either to reduce screen clutter or to keep information secret from someone looking over your shoulder.

My only serious reservation about Infoscope is its inability to produce derived or computed fields, a feature available on a fairly simple file management program such as PFS:Report. A derived field is one that performs a mathematical calculation on data stored in other fields. For example, if you're tracking inventory, one of your fields might include the number of a certain item you have in stock and another field might contain the wholesale price of one such item. In a database manager with derived fields, a third field could be set up so that it multiplies the number of items by the wholesale price and displays the result.

Data Retrieval

You can retrieve data in any number of fields you want on virtually endless combinations of criteria, including and, or, not, greater than, less than, equals, includes, and even sounds-like relationships.

Infoscope contains 45 such data-retrieval commands. (Many are synonyms or abbreviations for the same commands.) And Infoscope lets you add your own synonyms, which means you can write fairly natural-sounding queries. For example, after you've added a few words to Infoscope's command vocabulary, you could enter a search specification such as "show me all personnel hired before August 1983 except department is shipping." If you change your mind about some of the specifications in your queries, you can use the add or change commands to modify your original orders without having to retype the entire command.

You can link any number of files so that one becomes a subset of the retrieval criteria you have selected for a parent file; changing the cri-

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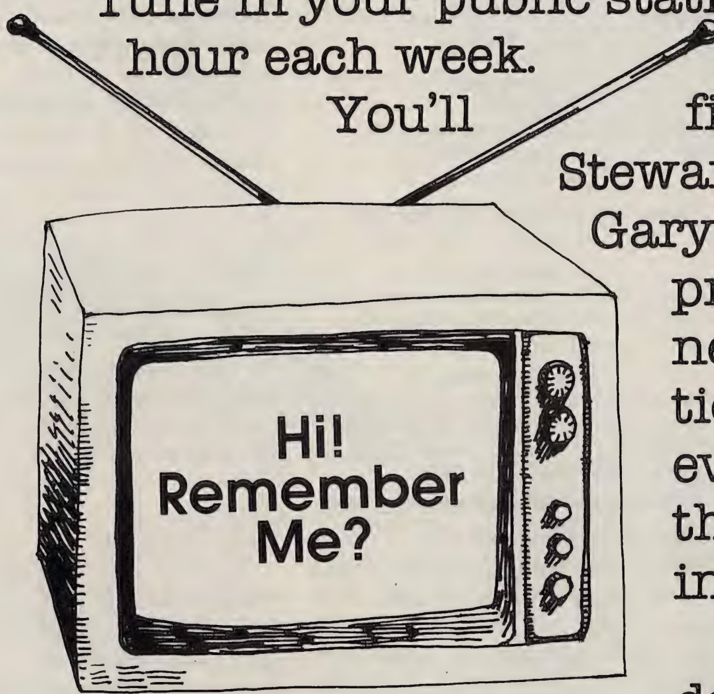

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teria in the first file automatically changes the criteria in the linked file. And you can create a new database that is a subset of a parent file.

Information can be sorted numerically or alphabetically in ascending or descending order on any number of fields, simultaneously.

Infoscope provides extensive options for formatting printed reports. These include headers and footers, which can be centered or printed against the left or right margins and include the current date and time. Infoscope supports boldface, italic, condensed, or other print characteristics, if your printer permits. You set up print formats through menu selections, and once you have a format you like, you can save it for future use.

Flexibility

Infoscope is a fairly solid database program. But beyond what you'd expect a useful database program to contain, this one has a user interface that warrants a close look.

Usually, software makes precise, nit-picking demands on people. Menu-driven programs often become tedious to use once you're familiar with the way the programs work. And strictly command-driven programs are often hard to use, although the payoff is more power and flexibility.

Infoscope combines the best of both worlds while eliminating the worst. Infoscope's seven-tiered menu structure groups commands according to the frequency with which they're likely to be used. Infoscope prompts you through making selections.

As you point to each selection, Infoscope displays an explanation of that command. Pressing the F1 key or the question mark key at any time will produce a help screen related to whatever operation you may be in the middle of at the time.

Once you've learned how the program operates, you can simply enter commands, bypassing the menus. You can use whatever combination of menus and commands will get you through an operation with a minimum of fuss.

Infoscope's commands are part of a macro language that you can use to customize the program. If you find yourself repeatedly using the same commands in the same sequence to carry out a routine operation, you can write a macro program that will do it for you. As well, you can create prompts, menus, and help screens to guide infrequent users through a complicated series of operations you may have devised.

Most command-driven programs provide only a single command word for each operation. Infoscope gives you a whole range of words that anybody might naturally use for any particular function. For example, say you want to focus on certain records in a database by specifying numbers in a particular field that are greater than 100. Infoscope allows you to enter that relationship as greater, over, above, more than, or larger. Additionally, if you'd prefer to say bigger than, you can enter the appropriate definition, and bigger will become part of Infoscope's permanent vocabulary.

Bells and Whistles

The term bells and whistles usually implies flashy but not really productive features. But once you get a look at Infoscope's collection of extras, you'll see that they're more than mere window dressing.

Many of Infoscope's extras involve ways of moving and finding your way about the workspace, in an effort to make it convenient to get around the fact that the open workspace is considerably larger than the portion that can be displayed at any one time on the screen. A small box in one corner works like a radar scope, showing your current position in relation to the total workspace. A "map" command will show overhead, side, and bottom views of the different windows being displayed.

Infoscope uses windowing extensively and permits you to display up to 12 windows containing information from as many as eight different files. Windows can be enlarged or reduced in size, overlapped, placed side by side, or put to "sleep" temporarily so that they don't take up screen space until you need to use them.

If you have a color monitor, each window can be made a different color and referred to in commands by its color.

Infoscope's spelling checker, in addition to its obvious function, can be used to find information in the database. If you can remember only that the name of a person you entered into a database sounds something like Jakowsky, you can use the command "sounds like Jakowsky" and the program will find names that sound similar as long as they begin with the same letter.

Round-up

Data files created by other programs, such as dBASE II, Lotus 1-2-3, and Multiplan, can be used by Infoscope, and in most cases you can write files that can be used by these programs. Because Infoscope's files are saved in ASCII format, they can also be used with most word processors.

Infoscope lets you use either the Microsoft or Logitech mouse and the Votrax, Echo PC, or similar voice-control systems.

The manual serves the purpose, and Infoscope's on-screen tutorial will help you get started. Both, unfortunately, contain distracting typos and minor inaccuracies.

Infoscope's inability to handle derived fields makes it unsuitable for accounting-type databases, but otherwise this is an impressive program. Its dual menu and command structure let you work with the program any way that's comfortable for you. As you become more adept at getting around within Infoscope, you can forsake the menus and achieve greater control via commands and the macro language. Its speed and power in retrieving data are certainly in its favor, although the price you pay for these attractions is that your system's RAM size defines file number and size. Windows let you view records in more than one database at a time, and the spelling checker comes in handy. —RON WHITE

Ron White is the owner of Technology Marketing, a research and marketing firm in San Antonio.

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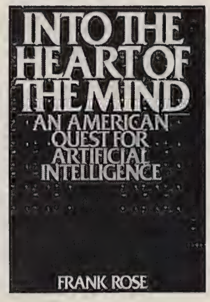

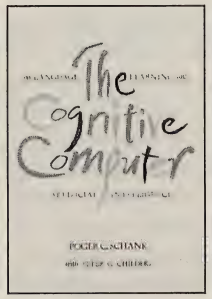

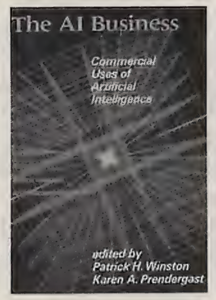

AI: From Myth to Money-maker

Into the Heart of the Mind
by Frank Rose

The Cognitive Computer
by Roger C. Schank with Peter G. Childers

The AI Business
by Patrick H. Winston and Karen A. Prendergast

Expert Systems
by Paul Harmon and David King

The construction of an intelligent machine has always been far enough from reality to have the flavor of a mythological quest. And like any good myth, the notion of machines that think has a long tradition in literature and film ("Will I dream?" asks the latest incarnation of Arthur C. Clarke's HAL). But is current AI research replacing the myth with reality, or is HAL himself still only a dream?

The books reviewed here aim to distinguish the realities of artificial intelligence from the myths. Each focuses on a different aspect of AI research: Frank Rose, in his *Into the Heart of the Mind,* records the work of a Berkeley AI team; Yale professor and AI entrepreneur Roger Schank articulates his controversial positions in *The Cognitive Computer;* Patrick Winston and Karen Prendergast offer a collection of papers from an artificial intelligence colloquium in *The AI Business;* and Paul Harmon and David King provide a survey of a single application area in their *Expert Systems.* This wide spectrum of opinions and approaches accurately reflects the current state of artificial intelligence research, a field still marked more by the questions it poses than the puzzles it's solved.

Rose's *Into the Heart of the Mind* (Harper & Row, 1984, $15.95) is by far the most readable of the four. Expanding on a series of articles that first appeared in *Esquire*, the book conveys on a personal level the drama, frustration, and rewards of AI research at the University of California at Berkeley.

Rose appropriately opens with a screening of *Young Frankenstein* at a meeting of the Berkeley Computer Club; not only are the mad professor's soliloquies on the creation of artificial life played for full effect, but the style that Rose adopts here and throughout the book can best be described as cinematic. He zooms in on an afternoon lecture and then pans back for an overview of the cognitive approach that the lecturer espouses. In an example of cinema verité drawn from the best Frederick Wisemann tradition, Rose roams the corridors of Evans Hall, focusing his lens first on Robert Wilensky, head of the artificial intelligence department, then capturing Wilensky's relative position in the psychological, philosophical, and computer science issues surrounding AI research.

Wilensky, it turns out, studied under Roger Schank at Yale, and while sharing his mentor's ideas about the preeminent role of cognitive psychology in shaping AI thought, he has since developed his own experimental approach. One of Wilensky's students demonstrates that approach in developing an AI program named Pandora. Rose traces the story from the first conceptual glimmerings to a full-function program as Pandora "reasons" its way into putting on a raincoat before going outside in a downpour to retrieve a newspaper. Though actual code illustrates each step of the process, these discussions are strictly nontechnical—Rose is more interested in giving the reader a general feel for the methodologies.

Detractors of AI research are given equal time to articulate their opposing views. Conceptual swords cross in heated classroom debates with no clear winners, just new levels of conviction and entrenchment.

Rose is particularly adept at illuminating these large issues with the detail of individual lives. He concludes the book in this vein as he interviews Roger Schank, whose work represents one of the main schools of current AI research. Rose describes Schank as "the enfant terrible of artificial intelligence, the man who showed the giants of the field what they were doing wrong."

Schank, one of the most frequently interviewed of the main players in

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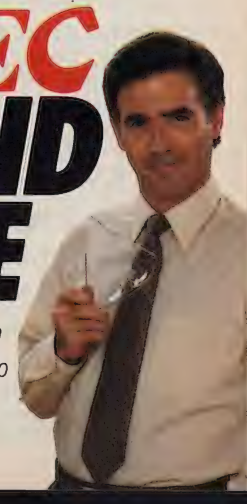

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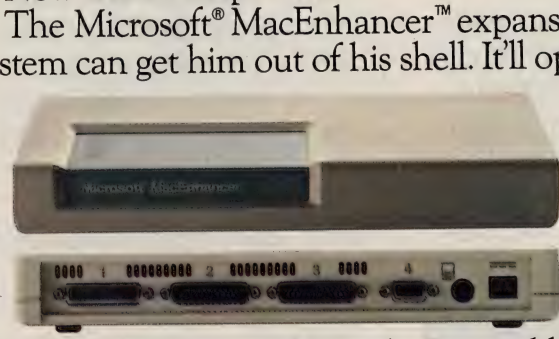

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Article No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Excellent	1	5	9	13	17	21	25	29	33	37	41	45	49
Good	2	6	10	14	18	22	26	30	34	38	42	46	50
Fair	3	7	11	15	19	23	27	31	35	39	43	47	51
Poor	4	8	12	16	20	24	28	32	36	40	44	48	52

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7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217	227	237	247	257	267	277	287	297
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today's AI game, eventually decided to pose both the questions and the answers in *The Cognitive Computer* (Addison-Wesley, 1984, $17.95), his own statement on the quest for intelligent machines. Ever the iconoclast, he unfortunately begins his book with an ill-informed attack on the user-unfriendliness of today's personal computers. For example, Schank states that the ability to access large databases is "not readily available to individual consumers," and "even if you can find a database that is of interest to you, you have to learn a 'query language' in order to access it."

As tens of thousands of subscribers to The Source and Compuserve are aware, this is simply not true. Schank provides equally myopic views on the etiology of the shakeout among computer manufacturers and the inverse ratio of human expectation and computer capacity.

Once Schank's view narrows to the pioneering work he has done as director of Yale's Artificial Intelligence Project, his own book comes closer to matching the reader's grand expectations. He neatly summarizes the cognitive view of AI research: "Process is what human thought is all about. Process is what computers are all about." Schank explains some of the rudimentary concepts involved in AI programming, illustrating his discussion with programs written by his research staff at Yale. Uniquely "Schankian" systems of representing concepts and structuring knowledge are lucidly described by their originator.

Systems like these, says Schank, will eventually enable the home computerist to take advantage of cooking, investment, and medical services with unparalleled ease. In an epilogue entitled "The Entrepreneurial University," he argues for a new, hybrid computer science department, responsive to "the economic realities of our times," that will provide such services. Schank, it should be noted, has also been a pioneer in simultaneously holding positions as a member of the Yale faculty and as the head of a number of private, "product-directed" artificial intelligence businesses.

This nexus of artificial intelligence research and the business community is the subject of Winston and Prendergast's *The AI Business* (MIT Press, 1984, $15.95). Their "book" is actually a collection of papers presented at a colloquium sponsored by MIT and F. Eberstadt & Company, an investment banking firm. These minimally edited transcripts presuppose familiarity with specific developments in the AI field, an approach that effectively cuts off any novice interested in an AI business primer.

What even the more well-versed reader will find, however, is only a marginally interesting study of the state of business-oriented AI research. Winston and Prendergast have divided the papers into four main groups: Expert Systems, Work and Play (a hodgepodge of programming tools, natural language user interfaces, and musings by the head of Atari's advanced research division), Robotics, and Today and Tomorrow (thoughts from Marvin Minsky and investment bankers). Presentations that are, at times, more self-promoting than enlightening summarize work at MIT, Stanford, Yale, and such private companies as Artificial Intelligence Systems and Daisy Systems. *The AI Business* is, in fact, the least credible of the books we reviewed.

An infinitely better treatment of this subject—one that manages to inform at a technical level while retaining some semblance of a popularized, readable format—is Harmon and King's *Expert Systems* (Wiley & Sons, 1985, $16.95). The authors, one a psychologist, the other a management consultant, have written this book "for executives, middle managers, computer systems personnel and corporate trainers" with the "goal of providing a broad overview of expert systems and their business applications." Not only does this excellent volume clearly treat fundamental concepts, but its chapters on applications provide one of the first summaries of microcomputer expert systems.

Graphics and charts throughout early chapters help to explain basic concepts and techniques. Classic expert systems like the medical advisor Mycin are examined at progressively deeper layers of detail for clues about underlying principles and design. As this approach suggests, the authors hope to reveal the technical underpinnings of the knowledge representation schemes informally described by Rose and Schank, as well as to demonstrate to the serious reader just how the use of these and other advanced coding techniques produces powerful new business systems.

After treating state-of-the-art knowledge engineering techniques, the authors survey commercially available tools and systems. Each of these surveys includes a product overview, some comments on the knowledge and inference strategies used, the level of user interface, and details on price and implementations for various machines. A comparison of features, including sample screens, gives some indication of the types of mainframe and minicomputer programs that will probably be available to personal computer users in scaled-down versions in the near future.

This balance of incredible and valuable detail within a comprehensive scope makes Harmon and King's *Expert Systems* a book that's destined to be at the top of most AI reading lists for some time to come.

Is the idea of intelligent machines evolving into a reality? Even the most advanced expert and natural language systems described by Rose, Schank, Harmon, and King are, by their authors' own admission, incapable of passing any of the proposed tests for machine intelligence. It is difficult, however, to read in these books about the advances of the last few decades and not extrapolate to a time when science fiction becomes science fact, when a synthesized voice asks, "Will I dream?"

—MIKE NICITA & RON PETRUSHA

Mike Nicita and Ron Petrusha are coauthors of *The Reader's Guide to Microcomputer Books*, 2nd ed. (Golden-Lee, 1984).

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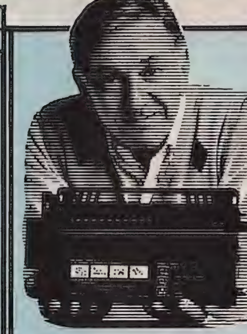

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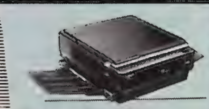

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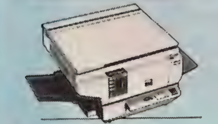

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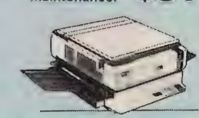

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ASK POPULAR

This month, readers' questions range from interfacing to database design

MOST DATABASE PROGRAMS FOR the IBM PC work with the program disk in one drive and the data disk in the other. Can my database program (Dataease) use more than one drive for data, so that my files can extend continuously to multiple disks?

—MELVIN DOUGLAS
BRONX, NY

NO. CERTAIN GROUND RULES govern database design. They include such things as the number of records handled, whether the program simplifies user interaction with a menu, and whether records can be contained on more than one disk drive.

For many database management functions, files that span disks cause major problems and require extensive additional program code. Consequently, most database programs do not allow files to span disks and assume that the user's storage device has sufficient capacity. Dataease does not allow you to continue your data files on additional disks, and thus limits your file size.

However, depending upon your application, you may be able to circumvent this limitation by dividing your data into logical groups. For example, you might have one disk with pre-1984 data and another with 1984-1985, or clients with last names A-M on one disk and N-Z on another. You may have to repeat some procedures, once for each disk, but you'll effectively double your storage.

Of course, the best solution is a hard disk. Then you can measure your file size in megabytes.

I HAVE HEARD THAT THE COMmodore 64 memory can be expanded to 128K or 256K bytes by just inserting chips. If this is the case, where can I purchase them?

—THOMAS D. SERRAGO
LANCASTER, PA

UNFORTUNATELY, THIS IS NOT THE case. The memory chips in the Commodore 64 are designed for 64K bytes of storage capacity. You can't replace them with larger memory chips because additional signal lines would be needed.

It is possible to "piggyback" the existing memory with another set of 8 chips and switch between them with a combination of hardware and software techniques known as "bank switching."

This complicated modification would still give only 64K bytes of active memory at a time, because that's all the microprocessor chip can recognize. In addition, the operating system and software would require modification.

The minimal benefits from these complex modifications aren't worth the risk of damaging your computer.

I AM LOOKING FOR A STAR TREK program for my Coleco Adam computer. The Adam's "Smart BASIC" is similar to Applesoft but uses different PEEKs and POKEs. How can I find such a program?

—C. THOMAS
SAN DIEGO, CA

GAMES WRITTEN FOR ONE COMPUTER often will not run on another, even when they are written in BASIC. However, many BASIC programs are "almost" machine independent and do not use the unique graphics features of individual computers. Fortunately, Star Trek is one of these programs.

Basic Computer Games, edited by David H. Ahl (Workman Publishing, $7.95), offers 101 games that run on most computers using BASIC. Each program contains an introduction, sample output, and complete listing. Super Star Trek is included. *More Basic Computer Games* ($7.95) is a sequel that features 84 additional games. Both books have been in print for several years and are available at most bookstores.

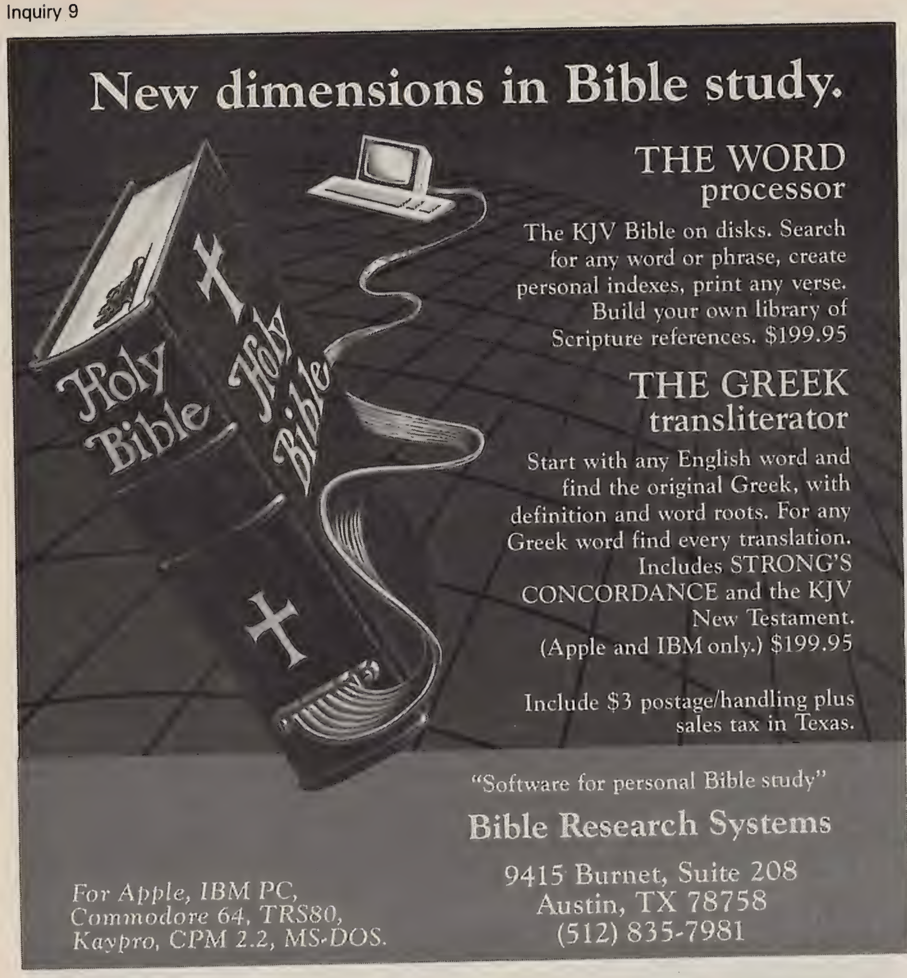
Another source of programs for your Adam is *Coleco Adam Entertainer* by Brian Sawyer (Osborne/McGraw-Hill, $12.95). It features 30 BASIC programs that take advantage of the special graphics and sound features of the Adam and includes complete program listings.

I HAVE A COMMODORE 64 WITH A monochrome monitor and eventually want to purchase an Apple Macintosh and an IBM PC AT. I want to take full advantage of color graphics on all three but am afraid that my apartment will look like a TV showroom.

Is there a high-resolution composite/RGB monitor that can be switched to all three computers?

—STEVE EISENBERG
NEW YORK, NY

NOT REALLY. MOST COLOR MONITORS will accommodate either composite or RGB (red-green-blue) video, but not both. A composite video signal combines the video and timing information into a single line; RGB input requires three separate lines. These inputs are handled differently inside the monitor, making commonality difficult. The RGB monitor has much higher resolution and can display more pixels, or picture details, on the screen.



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The Commodore 64 outputs a composite video signal and will not work directly with an RGB monitor. The Apple Macintosh is designed only for monochrome (black-and-white) graphics or text. Its monitor is built in and there is no external connection. The IBM PC AT will accommodate either color monitor, depending on the graphics card installed.

With this much incompatibility, a single monitor for the three computers is not feasible.

I TRIED TO TYPE AND RUN A PROgram from a magazine on my Apple IIe, but I had trouble because Applesoft BASIC does not use the INSTR command. Can you explain what INSTR does and give a substitute routine for Apple computers? —IGOR KIPNIS

SURE. THE INSTR FUNCTION (PROnounced "in-string") locates the first occurrence of a string (any group of characters) within another string and returns its starting position. As an example: in INSTR(N,P$, MK$), if the string MK$ is not found in the string P$, then INSTR=0. The N is a number that indicates where in the string (specifically, what character position) to start the search.

Suppose we want to find the first occurrence of the string MK$= "CDEF" in the string P$="ABCDEFGHIJ" and we start the search at the first character. The BASIC program would be:

```
10 MK$ = "CDEF"
20 P$ = "ABCDEFGHIJ"
30 PRINT INSTR(1, P$, MK$)
```

This program will give the value of 3, indicating that the string MK$ starts at the third character of the string P$.

The following Applesoft routine will perform the same function as INSTR(N,P$,MK$) and tell you the starting position (SP) of the string MK$ within the larger string P$:

```
10 PL = LEN(P$): SP = 0: IF N < 1 THEN 50
20 IF N - 1 + LEN(MK$) > LEN(P$) THEN
   50
30 IF MID$(P$,N,LEN(MK$)) = MK$ THEN
   SP = N: GOTO 50
```

```
40  N = N + 1: GOTO 20
50  (rest of program)
```

I SAW A PICTURE OF A COMMODORE 64 disk drive connected to an Apple IIe. Is there an interface that would allow this?

—MATTHEW GOLDBACH
LOS ANGELES, CA

THE COMMODORE 64 AND APPLE IIe use totally different methods of disk-drive control, making compatibility difficult. Commodore's "intelligent" drive contains the disk controller and the complete operating system. The drive's internal computer handles disk input and output (I/O) processing without tying up the 64. It is connected with a serial cable that allows other drives and a printer to be "daisy-chained" together.

The Apple IIe disk drive connects with a parallel cable that contains all of the data and control lines. ROMs on the Apple disk controller card and in the drive encode and decode information. The operating system for the Apple is loaded from disk, rather than being in memory at all times. Drive operation is controlled primarily by software.

Serial (I/O), though it can be used over longer distances, is generally slower than parallel. You could build a "box" to overcome the differences between the two drives, but the combination would be slow. Also, Apple-compatible drives cost less than the Commodore disk drive, making such a conversion uneconomical.

I HAVE AN APPLE II PLUS AND A COMREX CR-1 printer. My accounting program can generate 132-column reports on the printer, but I've been unable to do so with BASIC. Is there a way to accomplish this?

—EDWARD WEIGLE
LA JOLLA, CA

SURE. YOU MUST FIRST TELL THE printer that you want the 132-character mode, and this is usually accomplished by sending it a special, nonprintable code. This code, often the Esc (escape) character followed by a letter, can be found in the printer manual.

For example, if the required code is Esc M, the following BASIC statement will "toggle" the printer into the 132-character mode: PRINT CHR$(27) "M".

CHR$(27) is the ASCII symbol for Escape and is usually used with another character. The printer will stay in this mode until it is toggled back to the 80-character mode. If that code is Esc P, the command PRINT CHR$(27) "P" will return it to normal pitch.

Other printer functions can be invoked by similar commands. Consult your instruction manual for the specific codes.

I AM TRYING TO MASTER MY WORD-processing program, but something is wrong with my saving procedure. After saving several files to disk, I can retrieve only the last one. All previous files are missing. I have two disk drives. Each time I save a file, drive 2, to which I am saving, acts normally. What is my problem?

—HARRY FEYER
HOMER, ALASKA

IT SOUNDS LIKE YOU ARE GIVING each file the same name. When the latest file is saved to disk, it overwrites the previous file of the same name and completely replaces it.

Another possibility is that you are using the wrong command for retrieving files. The file you saved last is still in memory, and that is the one that shows on the screen.

A simple test should determine your problem. Create a few short files and give each a unique name. Save each to disk and exit the program. Using the CATALOG or DIRectory command from your disk operating system, see if these files are on the disk. If so, go back to the word processor and try to retrieve them. If they are not on the disk or you cannot retrieve them, consult the instruction manual to find the correct command. □

Ask Popular is a monthly column conducted by contributing editors Harv Weiner and Steve Ciarcia to answer general questions about small computers. Send your questions to: Ask Popular, POB 397, Hancock, NH 03449.

Inquiry 31

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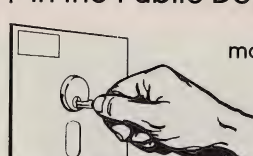

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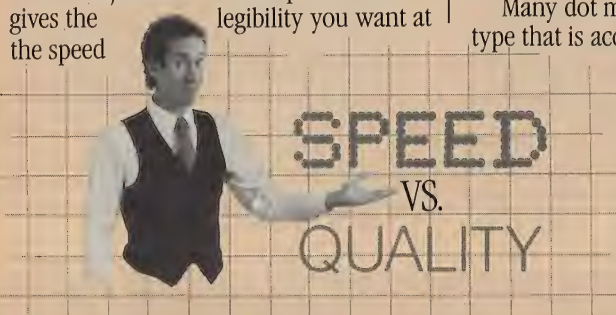
Here's some easy-to-understand facts from Legend to help you make a "clear choice."

How Do You Know You Chose The Right Printer?

Legendary Legibility.

There are trade offs in buying printers. Simply stated, within a given price range, quality, or legibility, decreases as speed increases.

The object is to find the printer that gives the legibility you want at the speed you need and at the price you can afford, like a Legend.



Legend printers have nine-wire heads and fast double-strike capability to maximize speed and quality.

Dot matrix type printers are the most popular and lowest cost printers. Most combine high speed with acceptable quality and legibility. They're extremely versatile and very dependable.

Legendary Head.

Dot matrix printers have print heads containing tiny pins that "fire" against a ribbon to make a series of dots that combine to form letters, numbers and graphics. Generally, the more pins or "wires," the closer together the dots, and the better the legibility.

Legend printers have "full nine wire" heads for better legibility.

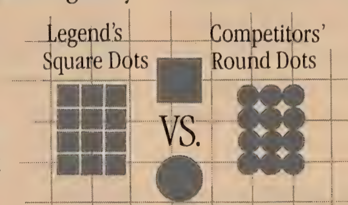
Many dot matrix printers produce type that is acceptable for about 95% of all correspondence—invoices, letters, and the like.

Daisy Wheel or "letter quality" printers run one fifth as fast and cost twice as much as a Legend. So a Legend dot matrix printer makes better sense. Why? Read on.

Easy to Switch.

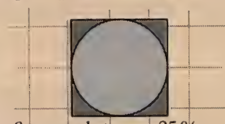
Many dot matrix printers have a "double strike" capability that reduces the speed, but produces better legibility.

Unfortunately, with most dot matrix printers, changing to the double strike mode is difficult. And, unlike Legend, most other printers only run at 25% of their normal speed.



Square dots butt better for higher legibility.

Legend printers have a special, easily accessible switch on the top of the machine so double strike capability (Legend calls it "damn near letter quality") is at the operator's fingertips. And machine speed stays at a very productive 50% of normal speed.



Square dots are 25% bigger than round dots.

Square Vs. Round.

In addition to speed, the shape of the dot affects the legibility of type, too.

Most printers use round dots. Legend printers use square dots because they butt better and fool the eye into thinking that lines are continuous.

Think of it this way. Imagine you stack a series of baseballs next to a series of equal sized blocks. Now move back 20 paces and look at the two stacks. Which one would look most like a straight line?

Legendary Graphics.

A picture is indeed worth a thousand words. And today's sophisticated software packages are making it easier to translate data into graphics that communicate quickly and clearly.

Legend 880—100 cps/80 col. Legend 1080—140 cps/80 col. Legend 1380—160 cps/80 col.

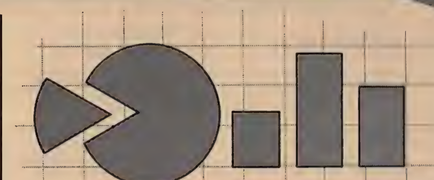
Legend 1385—160 cps/136 col.

Unfortunately, not all printers are capable of running graphics software, including some of the more popular models. If your application includes charts, graphs or other kinds of symbols, it's important that you pick a printer that is compatible with the software and capable of printing graphics, like Legend.

Legend printers are compatible with almost all popular graphics software programs. What's more, you'll get more characters built into memory when you choose a Legend.

More Graphics.

Most comparably priced printers feature 96 to 196 characters (symbols) built into memory. Legend printers have 228,



Legend printers have 228 characters in memory to produce more graphics and more languages.

so you can produce more graphics and more languages (French, German, Greek, Spanish, Italian) so you can be more productive. And isn't that the bottom line, really?

Legend's advanced square dot technology will make your charts and graphs look sharper, too.

A Head For Life.

No printer at any price is worth its salt if it's not dependable. Legend's square dot heads use a special alloy that maintains a sharper image and a longer life. So all Legend printers come with a lifetime head warranty.

If anything ever goes wrong with the head, simply send it back for an immediate exchange. It's so simple, it's legendary.

Legendary Value.

If there's still any doubt in your mind about which printer is best for you, we'll make your decision even easier.

Legend printers also come with standard friction and tractor feed and are compatible with most computers.* They feature over 40 software selectable type styles and make a crisp original plus three copies.

Most remarkable of all, prices start at just \$279. *And for just \$1 you can get a special buffer upgrade.* Compare if you like, but we'll bet you'll find Legend Printers, feature-for-feature, to be clearly the best value for your money today.

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Dealer inquiries call 1-800-321-4484. In CA call (818) 704-9100. Or write CAL-ABCO Peripherals Division, 6041 Variel Avenue, Woodland Hills, CA 91367.

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Hardware

SYSTEMS

New laptop computer: Radio Shack's Tandy 200 weighs just 4.5 pounds and comes with a 16-line by 40-character tilt-up liquid crystal display, fast scrolling, up to 72K bytes of RAM in three 24K-byte banks, a separate cursor key cluster, Copy, Kill, and Memory Bank function keys, and a 46-entry menu screen. In addition to the ROM-based software first introduced on the Model 100, the 200 also includes a ROM-based version of Microsoft's Multiplan spreadsheet, a calculator function, and built-in print formatting in the Text function. Another hardware improvement is an internal modem that offers tone dialing. The Tandy 200 is not completely software compatible with the Model 100; new ROM calls mean the system will reliably run only Model 100 BASIC programs; machine-language programs may not run. The computer will, however, work with Model 100 hardware accessories. The Tandy 200 with 24K bytes of RAM is priced at $999. Additional memory modules, which are user-installable, retail for $249.95 each. *Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102.* [INQUIRY 200]

Transportable computer: The Spectravideo Bondwell 12 offers CP/M compatibility and an internal voice synthesizer that speaks English words and sentences. The 27-pound unit features a Z80A microprocessor, 64K bytes of RAM, two 5¼-inch floppy-disk drives, and a 9-inch amber nonglare monitor. Also provided is a detached 63-key ASCII keyboard that includes a separate numeric keypad and 16 user-programmable keys. The Spectravideo Bondwell 12 costs $995 and comes bundled with applications software. *Bondwell, 3300 Seldon Court Dr., Fremont, CA 94539.* [INQUIRY 201]

PRINTERS

Digital X-Y plotter: Heath's IR-5208 is available in kit and assembled versions. The single-pen unit draws virtually every type of graphic format; line segments are accurate to four-thousandths of an inch at a top speed of 6 inches per second. The IR-5208 is compact and light enough to be carried in an ordinary briefcase. The unit works with either bond paper or overhead transparency material and is priced at $349.95 (kit) and $499.95 (assembled). *Heath Co., Benton Harbor, MI 49022.* [INQUIRY 202]

Fast dot-matrix printer: Toshiba's $995 P1340 provides both letter- and draft-quality outputs at impressive speeds. The 80-column unit generates draft-quality text at 144 characters per second and letter-quality copy at 54 characters per second. It offers a 24-wire print head, a graphics resolution of 180 pixels per square inch, serial and parallel interfaces, proportional spacing, and software-selectable fonts and pitches. *Toshiba America, Information Systems Division, 2441 Michelle Dr., Tustin, CA 92680.* [INQUIRY 203]

EXPANSION BOARDS

Apple expansion boards: Extend-It is a 64K-byte memory module that attaches to Apple IIe's 80-column card, doubling the memory to 128K bytes. Extend-It ($129.95) supports double high-resolution graphics and is compatible with all Apple software. Super Serial Imager ($129.95) is a serial-interface board for the Apple II and IIe. The RS-232C-compatible device transfers high-resolution graphics from screen to printer and supports many 1200/300-baud intelligent modems. On-board firmware includes a full-function telecommunications program. It is compatible with Apple's Super Serial Card. *Apricorn, 7050 Convoy Ct., San Diego, CA 92111.* [INQUIRY 204]

High-resolution graphics card: Quadgraph is a $499 monochrome graphics card for the IBM PC that provides a resolution of 720 by 348 pixels, allowing you to view such graphics-oriented packages as Lotus 1-2-3, Symphony, and Framework on a monochrome video display. *Quadram, 4355 International Blvd., Norcross, GA 30093.* [INQUIRY 205]

Better Apple graphics: Graphics Tool Kit is a plug-in expansion board and software package that gives your Apple II or IIe a higher graphics resolution than an Apple Macintosh. Priced at $595, the system provides a screen display of 640 by 384

pixels, 16 colors, monochrome shading, and commands to save and load images to and from disk. A movable window lets you design 8- by 10½-inch graphics for output to a graphics printer. The system supports Applesoft BASIC and many printers and printer interface boards. Existing Applesoft high-resolution programs can be easily modified to work with the system. *Demco Electronics, 10516 Grevillea Ave., Inglewood, CA 90304.* [INQUIRY 206]

Low-cost local network: Gamma-Net 3.1 is a controller card for the IBM PC, XT, and PC Portable that allows multiple computer users to share a variety of commonly used peripherals. Gamma-Net runs all industry-standard software under PC-DOS and installs in minutes. The system supports a maximum data-transfer rate of 2 megabits per second, a data throughput of 300K to 400K bits per second, and CSMA collision avoidance and detection. Gamma-Net handles up to 255 users and can utilize either coax or twisted-pair cabling. Bundled software provides file-server and printer-server applications. Gamma-Net is priced at $299.95 per node. Each node can access up to four drives, three parallel printers, and two serial devices. *Gamma Productions Inc., Suite 102, 817 10th St., Santa Monica, CA 90403.* [INQUIRY 207]

TELECOMMUNICATIONS

Modem Spike Protector ($59.95) eliminates the errors, distortions, malfunctions, false printouts, and disk skips that can be caused by electrical-power transients entering through your modem's telephone connection. *Indus-Tool, 325 West Huron, Chicago, IL 60610.* [INQUIRY 208]

New modems: The Tandata Tm110 is a 300-baud modem that works with any RS-232C-equipped computer. The $178 full-duplex unit offers its own internal memory that stores ID numbers, passwords, and up to eight telephone numbers. The Tandata Tm200 incorporates all of the Tm110's features, but also adds a 1200-baud data-transfer speed and the capability to communicate directly with other Tm200 modems. The unit retails for $420. Both modems are imported from the United Kingdom. *U.S. Telecom, 315 Greenwich St., New York, NY 10013.* [INQUIRY 209]

MASS STORAGE

Four powerful PC peripherals: Masterflight combines a hard-disk drive, tape backup system, surge protector, and power director into a single unit that is compatible with the IBM PC, XT, and AT and fits snugly between the computer's system unit and video display. Masterflight includes a half-height 10-, 20-, or 33-megabyte hard-disk system, a half-height 20-, 40-, or 60-megabyte streamer-tape backup device, five power-direction switches (computer, display, printer, and two auxiliary switches), a locking security key, and an electrical power-surge protector. Masterflight system prices start at $4995. *Kamerman Labs, 8054 S.W. Nimbus, Bldg. 6, Beaverton, OR 97005.* [INQUIRY 210]

MISCELLANEOUS

Numeric keypad: Touchstone 2 for the IBM PC and PC XT is a plug-compatible, $199.95, 35-key unit with space, backspace, home, and enter keys. It also provides a complete set of cursor controls plus separate mathematics and symbol keys (including percent sign and brackets) that eliminate the need to press the shift key while entering compound formulas. A shift key permits the addition of a second level of keycodes. *Touchstone Technology, 955 Buffalo Rd., Rochester, NY 14624.* [INQUIRY 211]

Acoustical printer enclosure: Soundtrap XL is designed for use with large office printers that feature cut-sheet or tractor-feed mechanisms. The unit has two access lids, a cooling fan, and an angled cover that doubles as a copy stand. Options include a floor stand and a base extender that increases the enclosure's capacity. Soundtrap XL prices start at $449. *Trace Systems, 900 Stierlin Rd., Mountain View, CA 94043.* [INQUIRY 212]

MONITORS

14-inch monochrome display: Tatung Company of America's new TVT-7220 video display terminal, priced at $850, offers an ergonomic tilt/swivel enclosure and DEC VT220, VT100, and VT52 emulation. The unit also features a switchable 80/132-column display, 15 programmable function keys, and a detached keyboard. *Tatung Company of America, 2850 El Presidio St., Long Beach, CA 90810.* [INQUIRY 213]

Software

WORD PROCESSING/ TELECOMMUNICATIONS

Easy word processing: SRA Writer combines ease of operation with advanced features. It provides block moves, easy inserts and deletes, on-screen formatting, and a 19-line revision window. For the IBM PC; $75. *SRA Software, 155 North Wacker Dr., Chicago, IL 60606.*

File transfer: Wordlink lets you transfer word-processing files between an IBM PC and a DEC VAX minicomputer. The system, which retains all file formatting capabilities, is compatible with Wordstar and Multimate; $1300. *Data Processing Design, 1400 North Brasher, Anaheim, CA 92807.*

GRAPHICS

Presentation-graphics program: Graphics Editor/200 lets you create organizational charts, block diagrams, flowcharts, and process-flow diagrams. On-screen features include a drawing board, command menu, and status and prompt windows. Offers an easy-to-use, menu-based command system. For Hewlett-Packard Series 200 computers; $59.95. *Hew-*

lett-Packard, 1020 N.E. Circle Blvd., Corvallis, OR 97330.

Graphics editor: Imagination lets you create graphics, backgrounds, and sprites. Files can be merged together to produce animated "movies." Contains hundreds of predesigned images and movement tables. For the Commodore 64; $49.95. *Handic Software, Suite B206, 520 Fellowship Rd., Mount Laurel, NJ 08054.*

Mouse-driven graphics: Dazzle Draw provides 10 brush sizes and shapes, 16 colors, and 30 patterns. Other features include windows and pull-down menus, an electronic "slide show" mode, and a zoom option for close-ups. Cut, copy, and paste features let you swap images between pictures. Also works with a joystick or graphics tablet. For the Apple IIe and IIc; $59.95. *Broderbund Software, 17 Paul Dr., San Rafael, CA 94903.*

EDUCATION/PERSONAL

Business fundamentals: In Starting a New Business, a simulation, players choose one of three businesses and make the decisions that govern success or bankruptcy. For the Apple II family and Macintosh, and IBM PC and PCjr; $59.95. *Queue, 5 Chapel Hill Dr., Fairfield, CT 06432.*

Test-writing tool: Test-Writer enables teachers to build their own exam libraries. The program stores up to 250 questions on a single disk and supports several commonly used test formats, including true/false, multiple-choice, and short-answer questions. It also prints hard-copy tests. For TRS-80 Models III and 4; $39.95. *Teach Yourself by Computer Software, 2128 West Jefferson Rd., Pittsford, NY 14534.*

Financial aid planner: Study Money helps college students and their parents plan their financial-aid needs. The program includes an extensive database of financial sources and helps users identify the programs and awards they qualify for. For the Apple II family; $49.95. *Krell Software, 1320 Stony Brook Rd., Stony Brook, NY 11790.*

Financial tracker: RMRG: Accountant keeps track of your finances, including cash, check, and credit-card transactions. Classifications include source, amount, memo, category, and tax status. Reports can be printed by expense or income category for budgeting and tax calculations. For the Apple IIe and IIc; $29.95. *Rocky Mountain Research Group, 416 Arnold, Bozeman, MT 59715.*

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Software design tool: ADAPT (Application Development and Productivity Tool) helps nonprogrammers design custom software. The system, which interprets your plain-English instructions, can be used for a variety of applications. For the IBM PC; $295. *Wilmes Systems Inc., POB 929, Notre Dame, IN 46556.*

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Plotting programs: Tech Plot and Tech Plot 2000 are for land surveyors. The systems let you create maps that include points, lines, annotations, north arrow, curve charts, and notes. Tech Plot and Tech Plot 2000 interface with the Survey 80 and Survey 2000 surveying packages, respectively. They support Hewlett-Packard, Bausch & Lomb, and Houston Instrument plotters. For CP/M-80-, CP/M-86-, and MS-DOS-based systems; $750 (Tech Plot), $1000 (Tech Plot 2000). *Disco-Tech, 600 B St., Santa Rosa, CA 95402.*

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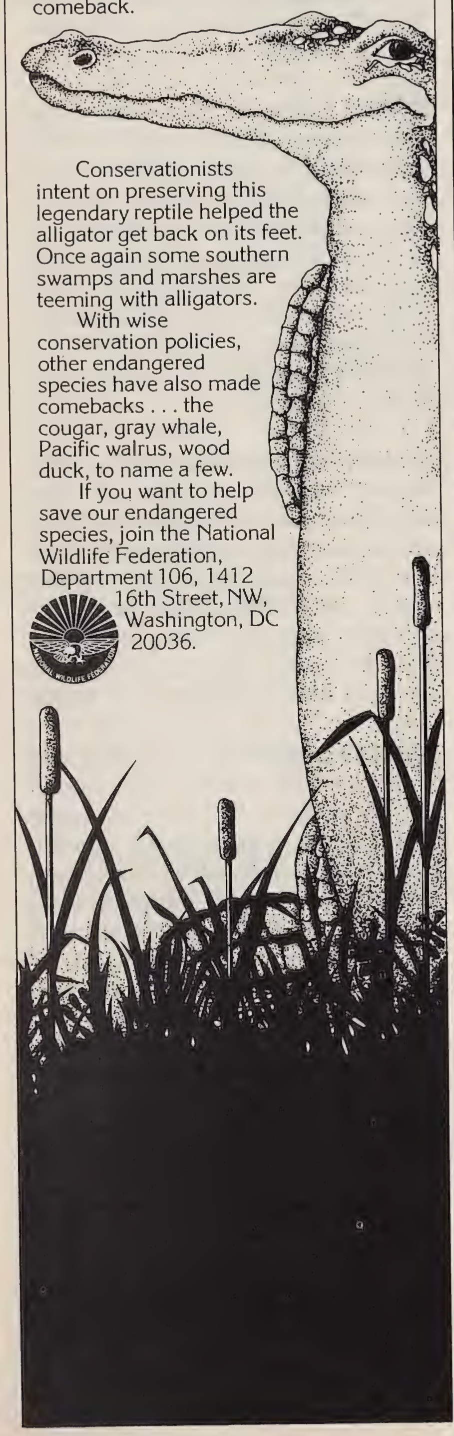

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Continued from page 69—
ambiguities practically always present in language as it is used by people. Given a sentence like "John took Robert to the hospital after he broke his collar bone, and, since it was raining, he decided to wait around while the doctor set it," a computer would be helplessly lost in all the pronoun and semantic ambiguities without some grasp of the meanings of the words.

Semantic proponents acknowledge that theirs is a demanding challenge. Roger Schank, who has managed to miff a substantial proportion of the AI community with his arrogant outspokenness, refers to the West and East Coast camps respectively as the "neats" and the "scruffies." "Neat people," he says, "like things formal. They wear nicely pressed suits and work on surface phenomena like logic and syntax because they can see and understand them. Scruffy people look sloppy and are perfectly happy working on hard, amorphous problems like semantics just because they're interesting, even if they can't see any possibility of a complete solution."

A self-proclaimed scruffy, Schank regards solving the natural-language problem as essentially equivalent to solving the entire AI problem. Before a computer can demonstrate genuine intelligence it will have to be supplied with elaborate knowledge structures and expectations equivalent to those that people acquire from their education and experience. This knowledge store provides the essential information needed to clear up ambiguities and fill in the blanks left by normal communication and by new experiences.

Observing that people rarely recall the exact words of things they have heard or read, but rather the gist, Schank and his colleagues concluded that people translate what they hear into private concepts, or "mentalese." They invented a computer version of this, known as "conceptual dependency," a simplified language that contains only 11 verbs in place of the hundreds in ordinary English. For instance, their synthetic verb "ptrans" stands for all the ways that an object can be physically transported from one place or one owner to another; these include move, buy, fly, and so on. The purpose of conceptual dependency is to create small frame-like structures of expectations to help a machine make sense of what it reads. Encountering a ptrans-type verb alerts the machine to search the text for clues as to what is moving, how it's moving, and what its origin and destination are. Once these slots are filled, the computer is a considerable way along toward understanding.

AND SO, growing numbers of AI theorists conclude that computers can never really be called intelligent until they learn to learn.

Schank and his Yale associates also developed more elaborate knowledge structures called "scripts." Resembling Minsky's frames, scripts are miniscenarios containing slots that outline stereotyped experiences. The "restaurant" script, for example, consists of the typical sequence of events that a restaurant customer encounters from the time he enters until he leaves. Told that John went to a restaurant, ordered a hamburger, paid the waitress, and left, the script enables the computer to infer that the waitress probably brought the burger and John probably ate it. Even with an abundance of scripts, computers have trouble understanding what people do unless they understand why people do anything. So Schank's students spend lots of time providing machines with other types of knowledge structures outlining typical human goals and typical plans and actions for satisfying goals.

Even without Schank's outspokenness, his approach evokes unusual vituperation in the AI community. Many of the West Coast's "neats" are AI engineers, people trying to design workaday systems or teach others how to do so. They are appalled by the implications if Schank's theories are correct. Semantic systems amount to immense collections of random knowledge and hypotheses about how the human mind, an egregiously complex if not messy entity, may actually go about its business. The programs are very large, very ad hoc—"kludges," as the engineers, might say. All that apparatus, that necessary superabundance of miscellaneous knowledge that seldom gets exploited, strikes engineer types as a violation of their instinct for efficiency and order.

An articulate spokesman for the engineers' point of view is Nils Nilsson, of SRI. Over the years SRI has probably done more applications-oriented AI research than any other organization. The author of a couple of AI textbooks, Nilsson led a widely publicized project that developed SRI's vision-equipped mobile robot, Shakey, in the 1960s. Nilsson, not John McCarthy, is probably one of those Schank has in mind in describing the prototypical "neat." He has trim, Scandinavian good looks, a concise and orderly engineer's mind, and is a fluent advocate of the logical approach to representing knowledge.

"People like Schank," Nilsson argues, "use more or less ad hoc schemes that more or less work for particular situations. Minsky's point of view is that intelligence really is built up out of ad hoc schemes held together with chewing gum and bailing wire and that somehow they work.

"Now, he may be right. But if he is, I don't think it's a very optimistic point of view because I don't think we'll ever be able to understand or engineer those sorts of things. The whole history of engineering has been to try to simplify and look for principles. I think that in building intelligent machines, we ought to at least try to have the same kind of engineering spirit. We need to look

Inquiry 22

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Inquiry 23

for fundamental principles to help simplify and build these things."

Nilsson says this leads to the following question: "Will we be able to use a branch of mathematics to understand the commonsense world that machines are going to have to know about in order to act intelligently? The branches of mathematics most relevant to understanding the world are branches based on formal logic. The tradition of trying to express assertions about life formally goes back to the philosophers; Russell and Frege and others used these formal logical techniques to express certain commonsense ideas much more clearly. In fact, the whole history of philosophy in this century has been the attempt to use formalisms to describe what they were arguing about. I think AI is a development of that. So the issue is whether you believe that there are certain things that are so ineffable that they just can't be described formally."

Whether the approach taken is scruffy or neat, it might take all the world's programmers many decades to equip, say, Moravec's writer-robot with the knowledge it would need for its fact-finding trip to Washington or to educate a robot ballplayer on the ballistics of pop flies. "Each piece of knowledge you put into a computer requires tremendous coding of new information," Roger Schank points out. "We simply can't hand-code those things."

How People Learn

Consequently, growing numbers of AI theorists, including Minsky and Schank, conclude that computers can never really be called intelligent until they learn to learn. In fact, as AI delves into what is meant by learning, it becomes hard to distinguish what is meant by learning from what is meant by intelligence. People apparently learn by observation, analogy, and generalization, comprehending new things in terms of things they already understand, creating increasingly abstract and economical theories about the world that allow them to guess and predict things they have no direct knowledge of. This type of inference from observation is called induction, in contrast to the deductions produced by logical operations.

One specialist in inductive inference is Stanford University's Douglas Lenat, whose remarkable program Eurisko steadily improves its knowledge, understanding, and performance through experience.

One feature of the program is that instead of merely thinking about external problems, it can think about its own thinking, employing processes not unlike introspection and the stream of consciousness that occupies the human mind nearly all the time. People constantly churn through their stock of knowledge and observations, reshaping and refining them into increasingly general heuristics and theories about the world.

Eurisko, in effect, runs "thought experiments," employing a stock of general-purpose heuristics to manipulate knowledge frames and slots. The experiments are guided by rules for deciding whether a discovery

is "interesting" or not—whether it displays unexpected regularities, peculiarities, or successes. On the basis of these discoveries, it can add to its stock of heuristics.

Lenat sees programs like Eurisko as potential "intelligence amplifiers" to aid human thought much as mechanical devices amplify muscles. Such programs might help people think about complex if narrow domains, suggesting new ideas, combining them in various ways, and identifying the most plausible.

It's likely that over the next 10 to 20 years, AI will begin providing various types of aids more sophisticated than the limited expert systems and natural-language and vision programs that have recently emerged. The next few years, for instance, ought to see natural-language advice-giving programs people can dial up and consult about, say, travel plans, financial planning and investments, retirement, even medical matters.

But as to when we might see human-like robots of the kind Hans Moravec predicts, that will probably take many years and many conceptual breakthroughs. It may even take vastly different types of computers from those we have now.

Tasks that lend themselves to strict rules, such as developing expert systems with narrow knowledge domains dedicated to specific jobs, have proved possible. General-purpose intelligent machines so far remain out of reach.

What AI most obviously lacks, in fact, are capacities to deal easily with the nonsymbolic, sensory world of the mosquito and other creatures, capacities that AI has traditionally disparaged as "low-level." Whether genetically preprogrammed or learned, these low-level traits are more important to biological survival than things that have more obvious rules and that we have to make an effort to learn—things like playing chess.

But low-level, sensory-like faculties may also be important components of genuine intelligence. Much of our thinking, for example, takes the form of mental images; it's likely that such images derive in some way from our highly developed visual faculties, which at present computers are far from emulating.

In addition, most routine human judgments seem based on intuition, on what feels right, rather than on logical analyses. Such intuitions probably have a lot more in common with the nonsymbolic, parallel, analog processing that goes on inside mosquitoes than with the symbolic, sequential processing that goes on inside digital computers and AI programs as we know them.

So, for now, artificial intelligence remains a potential yet to be realized. Scores of researchers are expending much energy en route to that goal. Practical applications from all this research can be seen in robotics, expert systems, and elementary natural-language facilities. But for all their impressive abilities, these machines can't think on their own. □

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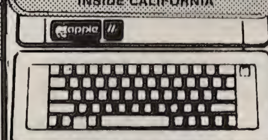

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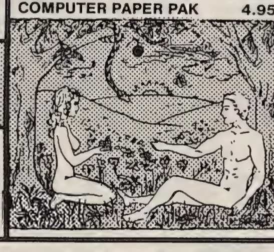

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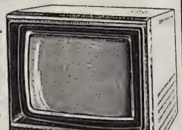

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THE INNER CIRCLE
AN INSIDER'S VIEW

Continued from page 65—

unwritten rules that formed the Inner Circle's code of ethics. Most hackers want to protect the account information they went to so much trouble to get. They want to stay out of legal trouble, if possible. They like computers and don't have any reason to cause trouble to them or the people who run them. They love the elaborate, complex logic of computer systems. People who find pleasure in destroying data are not motivated by love of the system or by respect for other hackers.

Most hackers share these traits, but depending on their motives, they also fall into one of five groups I call the Novice, the Student, the Tourist, the Crasher, and the Thief.

The Novice and the Student

Frequent references to the movie *WarGames*, mixed in with a few phrases like "Got any awesome numbers?" typify the Novice. These hackers are younger than most—maybe 12 to 14—so they often live off throw-away accounts from the more advanced Students I'll describe next. Novices think of hacking as play, or mischief-making, and they are the kind of hacker most likely to be drawn by the image of hacking as fun and somewhat "naughty."

Novices are very unpredictable because of their inexperience, and their population is rapidly growing because of recent glamorous publicity. But for the most part they are no threat to reasonably secure computer systems. Assuming that Novices can even get on to a system in the first place, they usually just log on and type PLAY GAMES, WITHDRAW $20,000, and CATALOG or DIR to see what sorts of file names the computer will display. Then they most likely get bored and go off to play Super-Invaders or do their homework.

When caught and confronted by a system operator—or another hacker—a Novice will almost always announce himself quite clearly. For example, members of the Inner Circle once detected an unknown hacker on a large system. To find out who he was and to test his capability, they sent a specially worded message to the new hacker: MARC, IS THAT YOU? An experienced hacker would have sent them some ambiguous reply or tried to hide his identity in some way. Instead, they received: I AM NOT MARC. I'M A HACKER HAHAHA! I'LL INITIALIZE YOUR HARD DRIVE IF YOU DON'T TAKE OFF!!!! They had contacted a Novice.

The second type of hacker is the Student, and I considered myself a Student. Students are bright, and they are bored with school. They are smart enough to know they have a lot to learn about computers, and what interests them most is what they can find out next. For me, and most of my friends, the excitement came in learning something I did not know a moment before. By the end of a typical day, for example, a Student may have visited several computer systems, whose total hardware value could be in the tens of millions of dollars, and he may feel that he has learned twice as much in one day as he did during the entire school year.

A Student would never intentionally damage a system because there's no reason that he should and many good reasons why he shouldn't. He spent as much as 20 or 40 hours just to get access to the system, and he wants to remain undiscovered, if at all possible, so he can keep using the computer. He also wants to stay out of any and all trouble. He spends long hours in cracking a system, so he respects the work of the system's programmers and wants to avoid giving them extra work. Besides, he knows that he may someday want to apply for a job with the company or perhaps request an account as a favor (it's very nice to get official use of a computer system).

However, assuming the Student has enough time, he will, out of curiosity, sooner or later examine every file on a system, and for companies with high-security systems and information to protect, this prospect can be dangerous. I have never known a Student to abuse information he found. But if that information reaches someone less ethical, the

potential for abuse does exist. One final note: A Student often roams undiscovered on a system until he walks in looking for a job with the company that owns the system. His resume shows that he's had three years' experience on the same computer that the company has, doing the same type of programming that the company needs done. Strange, but somehow Students seem to know just whom the company wants to hire . . . and when.

The Tourist, Crasher, and Thief

Unlike the Student, the Tourist is out for nothing more than an adventure or the challenge of solving a puzzle. Quite often he obtains an account, simply looks around for a few minutes, and leaves, never to return again. Why would someone spend so much time doing something without reward? For the Tourist, hacking is a form of mental game, like a crossword puzzle. The game ends when he succeeds in his quest to get into an unknown system.

Every now and then a Student or a Crasher (whom I'll describe next) will contact a Tourist and ask him to get a password to a particular system. When the Tourist decides to try such jobs, he succeeds probably eight or nine times out of ten—but it may take him as long as a year. A Tourist is a fairly safe hacker because he has no interest in being destructive. Using a system is not as important to him as it is to a Student. Getting in is the name of his game.

> **NOVICES are unpredictable but usually pose no threat to reasonably secure systems. Crashers try to cause as much trouble as they can.**

The Crasher, on the other hand, seems to operate with little or no logical purpose. He is a troublemaker, motivated by the same elusive goals as a vandal. If it weren't for computers, he could just as easily be spray-painting his name on the side of a building, or perhaps even setting the building alight. As far as I can tell, a Crasher's only purpose is to make himself as famous as possible among his peers and his victims. To attain this goal, he works to cause you as much trouble as he possibly can.

Usually, a company won't know it has a Crasher on its system until it's too late: the firm hears from an irate user that three weeks' work has been destroyed and finds the words THE MAD CRASHER STRIKES filling all two and a half billion characters

Inquiry 62

of the system's disk space.

I remember one Crasher who was bragging (a common activity) about how he crashed one particular system. He was proud of this feat because he had gotten the system operator's password—something genuinely worth bragging about. After getting the password, he waited a few days until the company was ready to back up the system according to a schedule he had found.

The Crasher waited until the time was right. Just before the backup procedure started, when his strike would damage the most data and thus have the greatest impact, he proceeded to erase all the files—no problem, if you have the system operator's password. Afterwards, he said something like, "I thought they would be down only a few hours and maybe lose a few days' work. But it's been over two weeks now and they are still down." He was very happy about that.

For the most part, Crashers usually don't stand very high in the estimation of other hackers. Crashers do three things that most hackers don't like: They give all hackers a bad name. They close down accounts that other hackers spend much time and effort to get. They often attempt to crash bulletin-board systems—the places that most hackers use to communicate. To sum it all up: They are not very nice guys.

The Thief is the rarest type of hacker. Although he is much more professional than any other hacker, the Thief's motives are perhaps the easiest to explain: He wants to profit at your expense. In a majority of cases, there is no direct financial gain involved; the profit usually takes the form of data stolen from a competing company.

There is a fair chance that a Thief will use a bribed or blackmailed employee, a wiretap system, or similar standard spying techniques in his plan. Much more often, though, a Thief is part of the company that is being robbed. He is seldom discovered and simply continues to drain away tens of thousands of dollars worth of information. The victim has no idea that anything is going on.

But by my own and most hackers' definitions, the Thief is not a hacker at all: He is a criminal. Most hackers feel that what they do is very different from what a Thief does.

Is It a Crime?

To most hackers, their browsing on a system is usually a harmless, "educational" pursuit. In the past year or so, however, I've come to realize that browsing raises some legal and ethical questions, such as: What constitutes invasion of privacy? What are the rights and privileges of the individuals involved? On a more technical level, to what degree are computer memory and electronically coded data entitled to protection under the law?

Such questions are now being considered at both the state and federal

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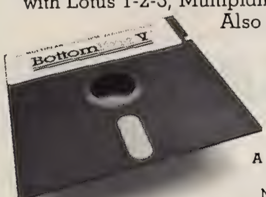

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Inquiry 34

levels, and laws may change to meet the challenge posed by hackers. New attitudes toward browsing are emerging, and I'm certain that hacking as I practiced it will soon be universally considered a crime—perhaps not as severely punished as more traditional computer crimes, but just as wrong. Back in the "old days" of 1983, however, while hacking wasn't right, it wasn't exactly wrong, either. And when I was arrested, it was on charges of wire fraud, because no other federal law was applicable.

Caught

I was living at home, with my parents and family, when the doorbell rang on the afternoon of October 13, 1983. But I wasn't completely surprised to see two gentlemen who represented the Federal Bureau of Investigation standing in the doorway with their identification and their warrants. The night before, I had called another member of the Inner Circle, and he had told me his computer equipment, floppy disks, and even his telephones had been seized a few hours earlier. Altogether, I later found out, Federal agents had visited at least nine members of the Inner Circle, in eight different cities, on the preceding day, October 12.

The agents entered my house and searched the premises. In the process they confiscated all computer equipment, any electronic equipment they did not understand, magnetic disks and tapes, my telephone, and all my notes and written logs. They took notes and made an inventory of the computer equipment they were taking. During this visit, I was asked a number of questions. I was also told that I was one of several people around the country who were involved in an FBI investigation regarding unauthorized use of the computer that was in charge of a service called Telemail, which is accessible from the GTE Telenet network service.

Several months after my initial meeting with the FBI agents, I was quite surprised to see all my confiscated equipment returned, via U.S. registered mail. Everything had been packed into a large cardboard box and protected with a little foam. Luckily the damages were quite minor—under $200.

Several months after that, I was indicted on three counts of wire fraud by a federal grand jury in Alexandria, Virginia. According to the indictment, I had accessed Telemail through a telephone number located in San Diego, California; I had acquired user names and passwords or access codes without authorization; and I had created accounts so that unauthorized people could use the mail system.

After consulting with my attorney, I decided to plead guilty to the charges. The United States Attorneys agreed to drop two of the counts if I pleaded guilty, leaving me with one count. Wire fraud is punishable by a prison term of not more than five years and a fine not exceeding $1000. Luckily, the prosecuting attorney agreed with a suggestion by my probation officer that I be fined $87 and perform 200 hours of community work. Before sentencing me, however, the judge decided he wanted psychological testing done on me. Finally, just over a year after I was caught, I was sentenced to three years' probation.

The Need for Security

The main reason that my case even existed was that the people at Telemail did not know how to secure their system against unauthorized users. If they had, they would have kept us out. The fact that GTE went directly to the FBI and did not ask us if we would leave or if we could help them makes me think that GTE was very serious about security but had no control over it.

This situation—a computer that needs security but doesn't have it—could be a very big problem, considering the fact that computers are controlling more and more of our lives every day. I think it is important that system owners, operators, and users have the knowledge to protect their systems from unwanted intruders. That's why I wrote this book. □

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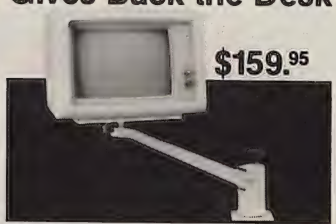

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Continued from page 72—
But now the technology has advanced to where some expert systems are available on microcomputers. Several companies are marketing expert system "shells," which are expert systems minus the knowledge base. Purchasers add their own store of rules to these shells.

One of the most powerful expert system shells available now for micros is Texas Instruments' $3000 Personal Consultant. The basic system runs on TI's Professional Computer and comes with the IQLISP programming language and two sample knowledge bases.

At the other end of the scale is Expert-2, a $69.95 shell from Miller Microcomputer Services in Natick, Massachusetts. Expert-2, which requires the MMSFORTH compiler, comes with four sample knowledge bases as well as the source code to the inference engine. This makes it an excellent way for beginners to learn about expert systems. It runs on TRS-80s and the IBM PC.

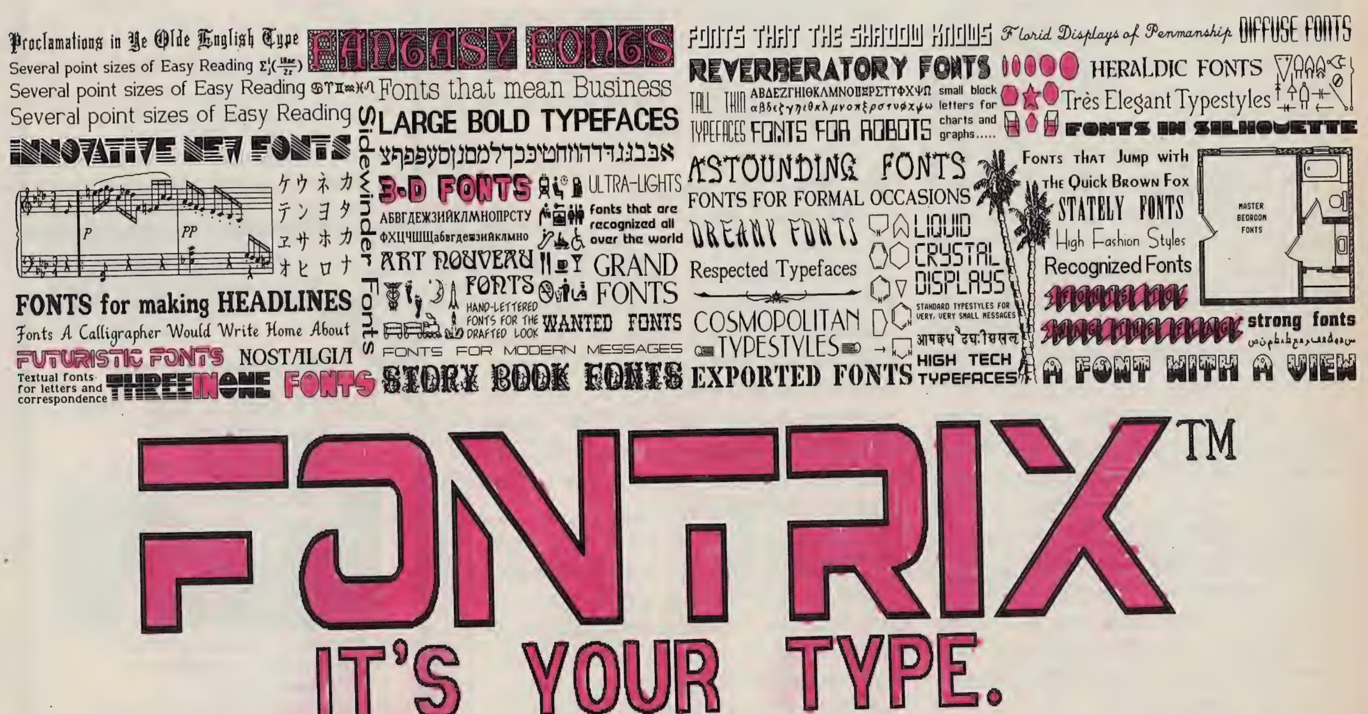
Expert Ease is probably the most popularly recognized expert system shell available for micros. Developed by the Scottish firm Export Software International, Expert Ease is now available from Human Edge Software Corp. of Palo Alto, California. (The original U.S. distributors, Jeffrey Perrone & Associates of San Francisco and Jeffrey Milman of New York City, are also both distributing the product.)

Expert Ease works inductively rather than deductively. Instead of entering rules, you enter examples of situations. The system then "induces" the knowledge base from the examples. Selling for $695, it runs on the IBM PC, DEC Rainbow, and Victor 9000.

In addition to these low-end systems, companies such as Silogic and Teknowledge are coming out with microcomputer systems in the $10,000 to $20,000 range.

Building an expert system is no small feat. The biggest problem is *knowledge acquisition.* An expert system's inference engine is usually a fairly small program, easily written in a few days or weeks, but the knowledge base is another matter. A large knowledge base is the key to an expert system's success. How do rules get into the programs? By a laborious dialogue between programmers and experts, in which the programmers try to elicit from the experts the processes they use to solve problems. The task is not an easy one, and not because the experts are secretive; rather, they don't quite know themselves how they reach conclusions. Their problem-solving skills have become second nature.

The current solution to the problem of filling the expert system with rules falls within the province of the knowledge engineers—expert systems programmers who are trained in extracting knowledge from experts. They know which questions



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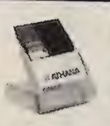

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will get the most information out of the expert, and they know how to translate the expert's answers into appropriate rules for the knowledge base.

Even with a knowledge engineer on the job, however, the bottleneck in developing an expert system is still in the process of creating the knowledge base. What's desperately needed is the ability for expert systems to acquire knowledge about their own domains.

Expert systems researchers make the distinction between rule-based and model-based systems, which are still the province of university research. A rule-based system like Mycin knows only that certain symptoms are related to certain diseases. A model-based medical expert system would know *why* the symptoms were correlated with the diseases. It would know that certain diseases are caused by bacteria releasing toxins into the bloodstream, others by viruses, and others by the failure of the body's immune system. Such an understanding should lead the program to a more accurate diagnosis of what biochemical and biological changes produced the symptoms and to better suggestions for treatment.

Even after the problems associated with developing and using expert systems have been solved—and they will be—it's doubtful that we would want to call expert systems intelligent. A medical expert system might perform as well as the world's finest doctors at medical diagnosis, but its golf game will be terrible. I'm not being totally facetious. Expert systems will be good at only one thing, whereas human experts, like human nonexperts, can do thousands of things well. We should hesitate granting the palm of intelligence to any program that, like an idiot savant, can do one thing well and others not at all.

Whether we want to call them intelligent or not, expert systems will be around, in science, in industry, and in the military. But it's important to remember that expert systems aren't the superintelligent computers of science fiction—just much more sophisticated cousins of the computer programs, such as airline and hotel reservation systems and automated banking systems, that make our lives so convenient. Thanks to advances in natural-language processing, expert systems will be able to communicate with us in our language, and any expert system worth its salt will have Mycin's ability to explain its own internal processes.

So expert systems won't be nearly as inscrutable and intolerant as the computer systems many of us deal with today. Far from being dehumanizing, expert systems will continue the trend begun with the earliest computer programs: they will take care of the trivial and boring, freeing human beings to expend their energy and creativity in ways that only humans can. □

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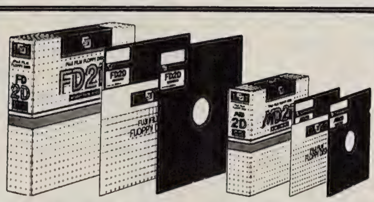

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Continued from page 77—
routines display a character onscreen, get characters from the keyboard, and do file-handling tasks.

You'll also need a manual or book about your computer's particular microprocessor that explains each instruction and, ideally, provides examples. In addition, books on assembly language and actual program listings can give you some guidance when questions arise.

Besides these references, you'll need an assembler and an editor, two programs that let you type in source code and convert it to object code. These programs are sometimes combined in a single package and sometimes sold separately. An assembler/editor that's fast and easy to use will make programming much simpler. All assemblers have syntax, punctuation, spelling, and spacing rules that you must learn. An assembler with more features and rules than you need can be cumbersome, so choose one that has as few rules as possible.

The speed at which the program assembles the object, or machine, code is important for efficiency. Some assemblers require that the source code be in a disk file; this type produces machine code as another file. A faster type of assembler eliminates the need to access disk files by assembling the source code in memory and translating the machine code in memory. You can then test the code and save it on disk after you debug it. Also, if the assembler and editor can reside in memory, you don't have to continually load them from disk and can save a good deal of time.

Macro assemblers let you develop standard subroutines to which you can assign names. These subroutines can be incorporated into the source code by using those names instead of rewriting all their instructions each time. Thus the source code is shorter and more readable, and it might even need less debugging since the individual macro routines are already debugged.

Editors are used to input and edit the text of the source code. These programs are usually line editors, which edit only one line at a time.

You'll also need a debugger, a program that lets you watch a routine execute and stop it at any point to examine the status of the registers and memory. It also enables you to single-step through a program, one instruction at a time. A good debugger skips subroutines that your program calls. Both the IBM PC and the TRS-80 have Debug programs that come with the operating system. The Apple's Monitor program, part of the operating system, has limited debugging capabilities.

A convenient though not essential tool is a disassembler, which performs the opposite function of an assembler: it converts object code into source code. A disassembler also lets

For TRS-80s: Converting a String to Lowercase

This program runs with Disk BASIC on TRS-80 Models I, III, and 4 with TRSDOS version 1.3. The program converts all characters in a string to lowercase. The source code shown here was generated by an assembler. You can load the object code directly into memory and save it as a disk file by using the Debug program that comes with TRSDOS.

The object code starts in line 160 (00160) at address FF00 in a 48K-byte computer (for a 32K-byte computer, use BF00; for a 16K-byte computer, use 7F00). To enter the code in memory, type DEBUG from the TRSDOS READY prompt. Then, depending on the amount of memory in your computer, type M and the correct address (M FF00 for a 48K-byte computer, for example) and hit the space bar. This puts you into the Modify memory mode.

Type in the code CD7F0A46, and so on. Check your code against the listing and hit either X or Return to exit the Modify memory mode. Now type Q to exit Debug. To create a file for the code, type the following and hit Return:

```
DUMP UPCASE/CMD (START=0FF00,
END=0FF20,TRA=0FF00)
```

Line 110 is a comment header for our convenience. Lines 120, 130, and 140 are equates that tell the assembler that the labels on the left equal the values on the right. Line 150 tells the assembler where it should start loading the object code.

Lines 160 to 220 initialize registers and memory locations. CALL GETA calls a routine in BASIC that puts the address of the string descriptor into register HL. Line 170 uses the address in HL to load register B with the length of the string. Then lines 180 to 220 initialize the registers so that HL holds the address of the first character of the string to be converted and register B holds the length of the string.

The conversion starts in line 230, labeled GETCR. This line loads the first character into register A. In line 240 the character is compared to A; if the character is less than 41, line 250 jumps to line 300, labeled SKIP. Lines 260 and 270 check to see if the character is less than or equal to Z. If the character passes both tests, line 280 converts it to lowercase. Line 290 moves the character back to the string.

Line 300 increments register HL to point to the next character in the string. In line 310 DJNZ (Decrement Jump Not Zero) decrements register B and jumps to GETCR if register B is not yet zero. If register B is zero, the next line is executed. In line 320, RET takes us back to BASIC. Line 330 tells the assembler that it has reached the END of the code.

After you type in the object code and save it on disk, load BASIC. When the program asks 'How many files?' hit Return to default to 3. When the program asks 'Memory size?' type in the decimal address of where the routine starts minus 1. If the routine starts at 0FF00—that is, 65535−256=65279—then 65279−1=65278 should be the top memory location that BASIC will use. Now type in the BASIC program.

Lines 40, 60, 105, and 110 interface the assembly-language routine with BASIC. Line 40 sets up the address

you list object code in memory as though it were in mnemonic form. Some disassemblers list the object code on the screen for inspection or printing; some produce source files that can be assembled. Disassemblers usually come with a debugger program. You can also buy them separately.

Learning assembly-language programming is much like learning a foreign language with all its rules and idioms. So be sure to keep your first attempts simple. Think out projects carefully and break up programs into shorter routines that you can test and debug. Just as it takes practice to become fluent in a language, fluency in assembly language demands practice. □

of our routine for the USR0 statement. Line 60 loads the routine into memory. Line 105 sets the variable A equal to the address of the string descriptor for S$. Finally, line 110 calls the routine to convert the string to lowercase. Lines 160 to 180 convert the string in BASIC.

```
                     00110  ;LABELS   MNEMON   OPERAND(S)
0041                 00120  AAA       EQU      'A'
005B                 00130  ZEE       EQU      'Z'+1
0A7F                 00140  GETA      EQU      0A7FH
FF00                 00150            ORG      0FF00H
FF00     CD7F0A      00160            CALL     GETA
FF03     46          00170            LD       B,(HL)
FF04     23          00180            INC      HL
FF05     5E          00190            LD       E,(HL)
FF06     23          00200            INC      HL
FF07     56          00210            LD       D,(HL)
FF08     EB          00220            EX       DE,HL
FF09     7E          00230  GETCR     LD       A,(HL)
FF0A     FE41        00240            CP       AAA
FF0C     3808        00250            JR       C,SKIP
FF0E     FE5B        00260            CP       ZEE
FF10     3004        00270            JR       NC,SKIP
FF12     F620        00280            OR       20H
FF14     77          00290            LD       (HL),A
FF15     23          00300  SKIP      INC      HL
FF16     10F1        00310            DJNZ     GETCR
FF18     C9          00320            RET
FF00                 00330            END      0FF00H
```

```
10  CLS:REM TRS UPCASE/BAS
20  CLEAR 1000
30  DEFINT X
40  DEF USR0=&HFF00
50  ST$="THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG."
60  CMD"L","UPCASE/CMD"
80  S$=ST$+ST$+ST$+ST$+ST$
90  PRINT:PRINT"STRING BEFORE CONVERSION TO LOWERCASE":PRINT
100 PRINT S$:REM STRING BEFORE CONVERSION
105 A=VARPTR(S$):REM GET THE ADDRESS OF THE STRING DESCRIPTOR
110 Z=USR0(A):REM CALL OUR ROUTINE
120 PRINT:PRINT"RESULTS USING ASSEMBLY LANGUAGE":PRINT
130 PRINT S$:REM PRINT THE RESULTS
140 S$=ST$+ST$+ST$+ST$+ST$:REM DO IT AGAIN IN BASIC
160 FOR X=1 TO LEN(S$)
170 IF MID$(S$,X,1)=>"A" AND MID$(S$,X,1)<="Z" THEN
    MID$(S$,X,1)=CHR$(ASC(MID$(S$,X,1)) OR &H20)
180 NEXT X
190 PRINT:PRINT"RESULTS USING BASIC":PRINT
200 PRINT S$:REM PRINT THE RESULTS
```

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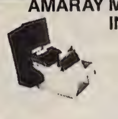

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REACTIONS

A showcase of comments, kudos, outcries, opinions, gripes, and grumblings

Black Market Macs

I want to congratulate you for publishing Steven Levy's "Black Market Macs" article in your January 1985 issue.

Most other periodicals talk a lot of "philosophy" stuff about ethics, but in the last two years of reading computer rags, I've never seen an article take on such an interesting double standard.

Thanks, Levy! The Spirit rings true! —GEORGE STEVENSON
PANDA PRESS
SACRAMENTO, CA

Tenth Anniversary

I thoroughly enjoyed your study of the first 10 years of the personal computer (Special Report, January 1985). I wondered what had happened since 1969, when I was studying "Basic Machine Language." I was chasing "flags" around a programming page and standing in line to feed cards into the refrigerator-sized IBM 3090. When a program failed, the lights and buzzers were no help—only an embarrassment.

Then last year the phenomenal Digital PRO-350 arrived. As each line is resolved in a flash I am continually aware of its profound influence on my life and future. This has been a truly remarkable decade for computing. —STEVEN A. HISS
INSTITUTE OF FOOD AND
AGRICULTURAL SCIENCES
UNIVERSITY OF FLORIDA
GAINESVILLE, FL

Writing from the birthplace of the microcomputer, I read with interest your article on the first 10 years of microcomputing. Legend has it that the first microcomputer got its name from an episode of *Star Trek*. The story goes that the *Enterprise* (in reruns by then) was traveling to the planet Altair at the precise moment that a name was needed for this newfangled computer and wham! the new kid on the block had a name.

While I do not know if this is how the MITS Altair in fact got its name, I do feel obliged to set the record straight: the *Enterprise* never journeyed to a planet called Altair. On stardate 3372.7 it was indeed on its way to Altair VI, but never in fact reached that planet. Captain Kirk diverted the ship to Vulcan to prevent Mr. Spock from succumbing to unrequited mating urges known as Pon Far.

The episode, "Amok Time," was written by Theodore Sturgeon and first aired September 15, 1967. It has been in the virtual memory of syndication ever since.

—BRUCE A. MANN, MD
DIRECTOR, MEDICAL INFORMATICS
DIVISION OF GENERAL MEDICINE
UNM SCHOOL OF MEDICINE
ALBUQUERQUE, NM

You're right about the legend. The Altair was publicized originally in an article in Popular Electronics *in 1975. Les Solomon, then technical editor, says that his daughter was watching* Star Trek *one evening. He asked her to help him think of a name for a computer. She suggested that he name the computer Altair because the* Enterprise *was heading there that night. Some former* Popular Electronics *editors have since observed that the naming of the Altair actually occurred in a more mundane way—during a staff meeting. Fortunately for computer history the Altair microcomputer arrived. You are correct, however, that the* Enterprise *never reached Altair, its original destination.—P.F.*

Last Words

Ah, how much I agree with Rick Cook's Opinion column in the January issue. As a sometimes writer I don't want to learn 63 different commands in order to write a two-page document. I'll promptly forget almost all of them and will simply return to pad and paper. Because of these perceptions I have refrained from getting a word-processing program. Maybe Wordvision is for me.

Who makes Wordvision; is it widely distributed?

—HARVEY WM. GLEEKSMAN
CRANBURY, NJ

Wordvision is published by Bruce & James, 680 Beach St., San Francisco, CA 94109; (800) 531-1309.

True BASIC

I read George Stewart's article on True BASIC in your November 1984 issue with a sense of déjà vu. Twenty years ago, the development of BASIC was an evolutionary advance in computer languages, and many or all of us have benefitted from its impact. We owe a debt to the originators of BASIC, just as we owe a debt to Neanderthal man and the stone ax.

But there have been many other languages developed in the intervening years, some encouraging, among other things, a more structured approach to programming. And there is nothing in True BASIC that is not present in these languages and in many others as well.

It does not seem as if the introduction of True BASIC provides any new insights or abilities to the hobbyist programmer. I wish that these talented computer scientists had directed their efforts to create something truly original and innovative,

READER FEEDBACK

Listed below are the articles in this issue with corresponding article numbers, page, and author references. To rate an article as Excellent, Good, Fair, or Poor, circle the appropriate number on the Reader Feedback portion of the Reader Service card.

RESULTS FOR FEBRUARY

The votes are in for the February issue and our Special Report on Low-Cost Computing contained three of the five best-liked articles. The report on Free Software apparently tickled a consumerist nerve in our readers; it ran way ahead of the pack.

1. FREE SOFTWARE
   by Glossbrenner
2. ASK POPULAR
   by Ciarcia, Weiner
3. LOW-COST PERIPHERALS
   by Edwards
4. BEST BUYS IN COMPUTERS
   by McMillan
5. FREECALC
   by Goley

instead of merely repacking old wine in new bottles.

—ROBERT J. SCHECHTER
LOS ANGELES, CA

Many people have noted similarities between True BASIC and other languages. Indeed, the ANSI committee, of which Tom Kurtz was chairman, evaluated the other languages when considering features to include in the new proposed standard for BASIC.

I disagree with your statement that True BASIC offers nothing new to hobbyist programmers. The vast majority of hobbyist programmers are working in versions of BASIC that, unlike True BASIC, don't support structured programming, don't permit external code libraries, and don't have matrix I/O, matrix algebra, GKS graphics, or built-in graphics transforms.

In fact, since the article ran, Johns Hopkins University, the University of Virginia, the Naval Academy, Haverford College, and Dartmouth were so impressed with True BASIC that they have adopted the language in their computer science programs.—G.S.

Solution to "Crazy Cancellation"

Recreational Computing's problem for April

```
10 PRINT
20 PRINT "This program finds incidences"
30 PRINT "of coincidentally correct"
40 PRINT "cancellations, as in 16/64=1/4"
50 PRINT "(canceling the sixes)."
60 PRINT "The program seeks only fractions"
70 PRINT "less than 1 with a two-digit"
80 PRINT "denominator. It ignores"
90 PRINT "mathematically correct cancellations"
100 PRINT "such as 10/20=1/2, 20/30=2/3, etc."
110 PRINT
120 INPUT "Press RETURN to begin";RT$
130 LET ER=.0001:        REM Error tolerance
140 FOR T=1 TO 9
150 FOR U=1 TO 9
160 FOR A=1 TO 9
170 FOR B=1 TO 9
180 IF T<>A AND T<>B AND U<>A AND U<>B THEN 360
190 LET NU=10*A+B        :REM Numerator
200 LET DE=10*T+U        :REM Denominator
210 IF NU<DE THEN 250
220 LET B=9
230 LET A=9
240 GOTO 360
250 LET Q=NU/DE          :REM Quotient
260 LET E1=ABS(Q-A/T)
270 LET E2=ABS(Q-A/U)
280 LET E3=ABS(Q-B/T)
290 LET E4=ABS(Q-B/U)
300 IF A=T AND E4<ER THEN 350
310 IF A=U AND E3<ER THEN 350
320 IF B=T AND E2<ER THEN 350
330 IF B=U AND E1<ER THEN 350
340 GOTO 360
350 PRINT NU; "/"; DE; "is a solution."
360 NEXT B
370 NEXT A
380 NEXT U
390 NEXT T
```

Thank you for an extremely interesting and informative article on True BASIC. I would like to know when a version will be ready for the Apple IIe. —RICHARD URMANN
LAUREL, MD

Don't hold your breath for an Apple IIe version. The company says that if it can figure out how to do one, it will. The problem is that True BASIC is much larger than existing BASICs, too large in its present form for the IIe. The company also says that it wants to avoid doing a "watered-down" version for any machine, even the Apple IIe.

Preliminary versions for the IBM PC are on sale now and final versions are scheduled to be available by the time you read this. IBM PCjr and Apple Macintosh versions are scheduled to be available during the second quarter of this year.—G.S.

I read with great interest your article on True BASIC. It looks good, but left me with a few questions:

Does it have variable length strings?

Does it permit erasing and redimensioning arrays in a running program? That is a real life-saver in chopping gigantic programs down to size and dealing with them in parts.

Does True BASIC require END at the end of every program, as in the article?

Does True BASIC have PEEK and POKE? Does it have GOTO?
—EDWARD L. TOTTLE
BALTIMORE, MD

True BASIC does have variable length strings. The 32K maximum is an upper bound, not an enforced minimum.

And, yes, there is some redimensioning of arrays allowed. In summary, you can change the number of elements, but not the number of dimensions, in an array. Note also that True BASIC subroutines that use arrays as parameters don't have to explicitly declare the number of elements included in those arrays.

The END statement is required. That's how the compiler knows the boundary between internal and external subroutines. Any function or subroutine that is defined before the END statement is considered internal—i.e., all of its variables are global (shared by this subroutine, the main program, and all other internal routines).

True BASIC has PEEK, POKE, and GOTO. It allows line numbers and all the line-numbered statements that are part of the "old" BASIC (the ANSI Minimal BASIC Standard).—G.S.

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Inquiry 79

Inquiry 11

Subversive Word Processors

Too much computer power can undermine a writer's efforts

A few of us who love writing on computers suspect that, in some dark way, machines have ruined our style. It's probably true. Most current word-processing programs simply outdistance our writing skills, and their promised ease turns out to be a deception. When programs are loaded with user-friendly, obsessively distracting features, an already difficult job can get out of control.

All writers face the same basic challenges of creating ideas, organizing information, and revising for a better effect. A computer could help them, but it really doesn't know how.

Simply trying to get started is a hard job for anyone, and any word processor that softened this block would be a help. It should encourage moving forward at top speed and saving corrections until later.

I like to think of this as separating creativity from analysis. Peter Elbow, a widely published teacher of writing, calls it "freewriting" and has shown that writers develop ideas more easily when they keep thinking of the subject and ignore trivial mistakes. Sophisticated word-processing programs don't understand this—they encourage instant revision.

Simple programs like Bank Street Writer, on the other hand, make shifts to the revising mode so awkward that users forge ahead out of necessity, abandoning all hopes of a perfect first draft. The rigidity irritates some, but many writers find their ideas flow more smoothly and their sentences sound less stilted. Because it will just boot up and go with no housekeeping, Bank Street Writer is comfortable, an Underwood among Selectrics.

Average writers fall back on pet rituals to plan their attack. They plot connections with elaborate maps, trees, and other designs, or they catalog relationships by outlining, listing, and serious notetaking.

Can a computer handle this planning more effectively? Well, at least it can make it neater. An outlining program like Thinktank emulates most of these creative strategies and has real potential for the writer.

I use it every day, but I'm still not good enough for it. I have this habit of tinkering with formal structures and conceptual arrangements, never seeming to know when to get busy and write. And who would? Outlining on a computer is so much fun that it's seductive.

So there goes style again. When an outline gets too good, it gets tight in the seams, leaving no room for the spontaneous thoughts and loose rhythms that separate quick writing from the dead. We learned that by doing outlines in high school.

Then there is revising. If you still believe that computers make writing easier, you're probably thinking about the power of insert and delete. Besides, moving blocks of copy is almost as much fun as outlining.

But too many writers squander this power on surface corrections and minor rearrangements. We move one awkward paragraph ahead of another and call it an improvement.

Not that we're lazy. We might not have seen the real problem. When that happens, a computer can get downright subversive and respond in a literal-minded way, as if all our commands were purposeful and exact. When we get really involved, we begin to think that they are.

I recently asked my students to rewrite some essays that they had turned in, and I watched while they processed their texts into flabby, textureless mush. They just Cuisinarted everything because it was easy. —JOHN STROMMER

John Strommer, a teacher of English and writing at the University of Rhode Island and the Community College of Rhode Island, has studied the effects of computers on writing for the past year.

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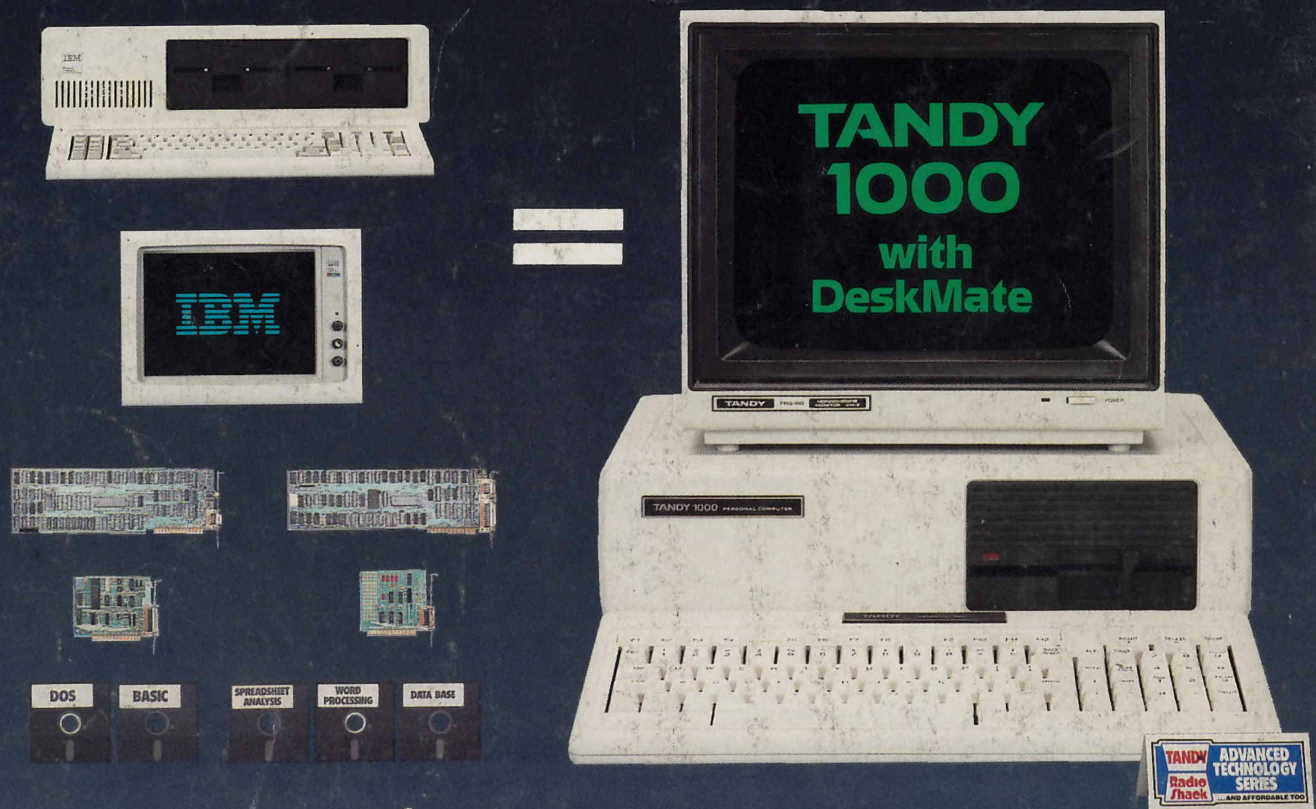

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